Electrical World

The consolidation of Electrical World and Engineer and American Electrician.

Vol. 57. NEW YORK, THURSDAY, APRIL 20, 1911. No. 16.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 West Thirty-ninth Street, New York.

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TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year. All other countries, $6.00 per year. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday of the week of issue.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of Electrical World for 1910 *was* 974,750. *Of this issue* 17,250 *copies are printed.*

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THE SMALL CENTRAL STATION.

The little Iowa plant described elsewhere in our columns is, we think, unique in showing how small a community can in these days be efficiently and economically served by an independent central station. If there is a regularly constituted central station for general service actually furnishing a town with energy for public and private lighting smaller than this one, we have yet to hear of it. A station rating of 25 kw certainly does not sound big, and yet the little plant under consideration means a great deal in the way of convenience and comfort to its community, is capable of serving it effectively and with a fair degree of economy, and altogether represents a type of enterprise that deserves to be encouraged. The introduction of economical and convenient gasoline-engine sets, which has been rendered possible by the lessons of the automobile industry, makes it practicable to establish electric service in many places which ordinarily would be considered beyond the possibility of economical service. In this instance, with a fuel expense of less than $2.50 a day, the plant, small as it is, stands an excellent chance of being a profitable investment for the community even if it merely covers expenses and depreciation, and with fairly good luck it should do even better than this. With no bonded indebtedness and common stock issued for cash only and subscribed for largely by those directly benefited, the plant would be a good civic investment even if it never paid a dividend. The balance sheet of this central station at the end of a year's operation will make very interesting reading and with good luck ought to show results that would encourage similar enterprises elsewhere. At all events there are few reasonably prosperous communities, like this one, so small as not to justify an effort at modern improvements even if they should have to be strictly of a co-operative character.

CHARACTERISTICS OF ILLUMINANTS.

Mr. Ladoff's discussion of the operating characteristics of various illuminants is welcome as bringing together a large amount of pertinent data from scattered sources, all bearing upon the efficiency and economy of sources of light. It is particularly instructive as giving in convenient tabular form an unusually complete mass of data on the cost of light from various illuminants, ranging from the stearine candle to the most efficient of the flame-arc lamps. This table deals with the cost of fuel or energy, omitting only the items which have to be taken care of in maintenance. The comparison on the whole loses none of its weight by this omission, for the reason that the incidental costs can readily be determined in any specific case and put on an actual competitive basis, while it is very difficult to tabulate them with average values which would hold good. The cost of fuel or energy, however, is a thing which can readily be reduced to a fair comparison once it is definitely stated on given terms. The costs as tabulated are in cents per 1000 international cp-hours.

An examination of the results shows that so far as cost of fuel or energy is concerned commercial illuminants fall into four groups, putting candles aside as incomparably the most expensive, although sometimes the most convenient, source of light. Into the first group fall gas flames in general and the carbon-filament electric lamp, with costs running roughly from 4 cents to 8 cents per 1000 cp-hours. The second group contains the metallic-filament incandescent lamps in their various forms, the Nernst lamp and the better class of modern carbon arc lamps. These show figures from 1.25 cents to 2.50 cents per luminous unit. Then comes a group consisting of incandescent mantle burners fed with gas and with petroleum. These range, roughly, from 0.7 cent to 0.9 cent per unit. Finally, another electric group appears, consisting of the quartz-tube mercury-vapor lamp and numerous varieties of flame-arc lamp ranging from about 0.2 cent to about 0.4 cent per 1000 cp-hours as the cost of energy. Obviously the inclusion of operative costs exclusive of fuel or energy would make very considerable differences in the total costs for these various groups. In particular the second and third groups would tend to come nearer to each other in total cost and there would be a considerable rearrangement of the fourth group owing to very material differences in the maintenance costs. The relative positions of the four classes, however, would remain substantially unchanged.

The author takes a useful step in again calling attention to the possibilities of light from so-called luminescent phenomena, such light as is emitted by gases and vapors under special conditions and by cultures of light-giving bacteria. The firefly, of course, is the best known instance of that luminescent light which seems to violate all precedents of light-giving bodies. Practically nothing has been done regarding the commercial utilization of any of these phenomena. Indeed, it is somewhat doubtful whether they will prove capable of utilization on account of the very low degree of luminosity found in most instances. Even the firefly is very dim judged by ordinary criteria of brightness, and if his secret could be effectively stolen the light produced would still be of a curious bluish or greenish cast, effective from the standpoint of luminous efficiency, but of perhaps limited applicability in a general way. Of course, there would always be the chance of correcting this color by some such device as Dr. Hewitt's interesting light transformer, but even with its aid the resulting light from any substance yet tried would still lack intensity in an inconvenient degree.

The chemical and biochemical methods of producing light certainly deserve more investigation than has yet fallen to their lot. In fact, the future of illuminants perhaps lies in the direction indicated by these somewhat occult phenomena. The light-giving powers of incandescent solids which obey Wien's law, at least approximately, have at the present time been pretty thoroughly worked out. It is perhaps a hard saying to insinuate that we have already played the limit so far as incandescent bodies are concerned, but as regards luminous efficiency alone it seems not altogether improbable that such is the case. There seems very little probability of any new element being found in commercial quantities of which the melting point shall be materially higher than that of the elements already utilized. Nor is there any reason to expect any combination of elements which will possess this greatly-to-be-desired quality. Certainly the possession of any higher melting points than are now known seems improbable, and this condition sets a limit to what can be reasonably expected in the way of improvements along this line. With respect, however, to those illuminants which, like gases, do not obey Wien's law there is much hope and there is a very wide field for investigation which has as yet been scarcely touched. The results already reached with the quartz lamp and with the flaming-arc lamps show how great a gap has already been established between selective and non-selective radiators as sources of light, and the possibilities of gaseous and luminescent sources are worth all the pains that can be bestowed upon them. The next decade should see notable advances in this direction, advances perhaps as great as those made within this first decade of the twentieth century.

DECISION OF SUPREME COURT ON PRICE AGREEMENTS.

A price agreement made by a manufacturing company for the purpose of maintaining retail prices paid by ultimate consumers was the important pivotal issue in a decision rendered by the United States Supreme Court on April 3, an abstract of which was published in last week's issue. Between this case and general price agreements there are some points of perfectly clear similarity. The contracts made by the company, a manufacturer of proprietary medicines, were with wholesale and retail dealers. Through violation of contracts, one dealer was able to purchase from other dealers at such prices that the goods were placed on the market at cut rates. Seeking an injunction against this practice, the manufacturer was defeated in the lower court, which dismissed the bill for want of equity. This judgment has now been affirmed by the higher court. Although the court declares that agreements between dealers which have for their sole purpose the destruction of competition and the fixing of prices are injurious and void, the decision does not appear to be a sweeping one applicable to all contracts. It classifies with the agreements which it condemns the form of contract in restraint of trade which was employed by this manufacturer, but it tempers the language in which it sets forth its attitude regarding contracts in restraint of trade generally. It recognizes that a modified application of the common law is required in the light of modern conditions and, by a broad conception of this truth, holds that restraints in trade that are reasonable for the public and the parties, and limited to what is fairly necessary for the protection of the covenantee, may be upheld. The opinion of Justice Holmes, who alone dissented, indicates that if the contract had made the retail dealers agents in law, as well as in name, it would have been beyond attack.

It will be observed that only a single manufacturer was concerned in this case. There was no union of manufacturers engaged in similar or partly competitive business, no attempt to restrict output was involved, and the articles affected are not the subject of patent. The main question, then, was as to the legality of the method of control by which the retail prices were to be upheld. Unfortunately, the court, although recognizing shades of intent in the law, does not lay down an inflexible rule as to what is reasonable and what is unreasonable restraint of trade. Since the court, after all, decides that the determination of such questions can be made only in view of the circumstances of each particular case, the decision is less enlightening than it might have been. Where obedience to the statute must accord with that interpretation which the court makes in each

particular case, the problem of conformity is surrounded with difficulty and peril. Slight differences in form rather than in purpose make the differences between reasonable and unreasonable restraint. Objections could be swept away and prices maintained by direct relations between the manufacturer and the ultimate consumer if it were possible to do without the convenient machinery afforded by the intermediate relationships with the jobber and retail dealer. In most industries, however, the convenience of the public is served best by the recognized and successfully intrenched channels for wholesale distribution in large lots and retail distribution in small lots. A reasonable degree of price rigidity is believed to be an economic necessity in these times. Barring definite restrictive acts, it is probable, therefore, that the operations of business will continue to tend toward price maintenance, with such reasonable agreements and reconstruction of the machinery of trade from time to time as may be required.

INTERNATIONAL SYMBOLS IN ELECTRICAL ENGINEERING.

The mathematical literature of any single branch of applied science, such as electrical engineering, can conveniently be classified in two divisions. In the first division would be placed certain stereotyped mathematical formulas which run through all the standard textbooks, formulas with which all engineers are more or less familiar and to which reference is frequently made in practice. Examples of such formulas are presented by the mathematical statements of Joule's law, Ohm's law, Kirchhoff's laws, the elementary laws of the magnetic circuit, the law of the dependence of the resistance of a wire upon its temperature, and so on. Reference is made so frequently to such formulas and to the quantities represented therein that it becomes very desirable to have the same symbols used for them by all writers. Uniformity in such symbols greatly simplifies mutual understandings and avoids unnecessary labor and confusion. Such uniformity is merely the standardization of intellectural implements. In the second division of the mathematical literature of the subject may be collected the great mass of theoretical analysis, which, however important it may be potentially, is of less general application. There is no sharp distinction between the second division of electrical engineering literature and the literature of pure electromagnetics. It is manifestly undesirable to standarize the symbols in the second division, mainly because there is no need for making the effort. Moreover, if the effort were made, it would probably be futile. The only justification for all such standardization is that the effort required to effect it is economically expended, since the saving in intellectual labor brought about by the memorization of a particular set of symbols should be very considerable.

It is to be observed that the symbols in the first division are very much fewer than in the second. The precise number of symbols in each is naturally a subject for debate, but it will generally be admitted that if thirty symbols be allotted to the quantities most generally used in electrical engineering textbooks the great mass of the mathematics in the literature of the first division would be covered and included; whereas it would certainly take hundreds, and possibly thousands, of symbols to cover and include all the mathematics of the second division. A comparative examination of the technology of electrical engineering would show that there is already a very fair degree of international agreement on a number of symbolized quantities. A particular research of this kind was published in the *Electrical World* for Aug. 12, 1909, in an article by Dr. A. E. Kennelly. Although there are numerous differences between the symbols used in different countries, yet it is remarkable how many are already alike. It evidently needs only a little giving and taking among electrical engineers in different countries to arrive at a satisfactory international list of symbols for all the mathematics of the first division.

The Brussels conference of the International Electrotechnical Commission last summer voted unanimously to recommend a certain list of eight symbols to the national electrical engineering societies and administrations for adoption at the next official convention, which is scheduled for next September at Turin. The quantities referred to are length, mass and time, in the fundamental units; e.m.f, inductance and electric quantity, in the electric units; flux density and magnetic force, in the magnetic units. On all of these quantities there already exists practically a complete international uniformity of symbology in a broad sense. That is to say, the same letter of the alphabet is used, almost without exception, for these quantities in all countries; but, in a narrower sense, the same symbols are not universally used if reference is made to the font of type employed. The French, who have always been most active in such classifications, have adhered to and recommended a Gothic script font for representing magnetic quantities, whereas in Germany and in Great Britain this script font, although not unknown, is less frequently used. However, the Brussels conference resolutions were restricted to the use of Gothic script capitals for magnetic force, flux density and inductance.

Some discussion has recently appeared on this question in *The Electrician*, of London. Objection is raised to the use of the Gothic script characters and preference is expressed for Clarendon font, or heavy square block capitals. As a matter of history, such block capitals were introduced into electrical literature largely in connection with three-dimensional vector quantities; whereas such quantities are ordinarily used in engineering with mere scalar meaning, or at most as two-dimensional or plane vectors. Nevertheless, if there exists in Great Britain a marked preference for Clarendon letters, rather than for Gothic script letters, that preference can be recognized with very little difficulty in the international scheme. In America, France and Italy the script letters are standard, in Germany they are partly standard, and in Great Britain they are seldom used. If, therefore, the International Electrotechnical Commission should finally adopt these capital letters, upon which there is no dispute, marking them in script to satisfy the majority, but noting that when desired Clarendon capitals may be substituted for script capitals, it would seem that all engineers would be content. In short, the question at issue is a mere font question, and not a question of what alphabetical letter should be used.

As for three-dimensional or true vector quantities, they have as yet no position in first-division literature, and are hardly considered by engineers. Two-dimensional or plane vectors, which belong to a quite different mathematical category, are, of course, much used in alternating-current literature. However, it is not necessary to distinguish specifically between a scalar and a plane vector quantity, although writers sometimes do so by means of a subscript or other device.

Association of Licensed Incandescent Lamp Manufacturers Dissolves.

The Association of Licensed Manufacturers of Incandescent Lamps, against which the Attorney General of the United States brought suit in the United States Circuit Court for the Northern District of Ohio, as mentioned in these columns March 9, has dissolved. This association manufactured lamps under patents of the General Electric Company, which as licensor now fixes the prices, terms and conditions under which lamps covered by patents owned by it are manufactured and sold. The companies involved in the dissolution are as follows: General Electric Company, Westinghouse Electric & Manufacturing Company, Westinghouse Lamp Company, National Electric Lamp Company, Ætna Electric Company, American Incandescent Lamp Company, Banner Electric Company, Brilliant Electric Company, Bryan-Marsh Company, Buckeye Electric Company, Capital Electric Company, Colonial Electric Company, Columbia Incandescent Lamp Company, Economy Electric Company, Fostoria Incandescent Lamp Company, Franklin Electric Manufacturing Company, General Incandescent Lamp Company, Independent Incandescent Lamp Company, Kentucky Electrical Company, Liberty Electric Manufacturing Company, Munder Electric Company, New York & Ohio Company, Shelby Electric Company, Standard Electric Manufacturing Company, Sterling Electric Manufacturing Company, Sunbeam Incandescent Lamp Company, Warren Electric & Specialty Company and Gilmore Electric Company.

Reduction in Incandescent Lamp Prices.

Some details of the price reduction made by the manufacturers of incandescent lamps in general on April 1 have just now become available. The prices of standard carbon lamps remain unchanged, but the higher efficiency lamps have been subjected to a price reduction approximating 10 per cent from the list prices. List prices are, however, subject to a discount ranging from 15 per cent and 10 per cent up to 20 per cent, 15 per cent, 10 per cent, 5 per cent and 2.5 per cent, depending on the number of lamps purchased during the year. For instance, the 50-watt Gem lamp, which was previously listed at 23 cents, is now listed at 21 cents. The 25-watt tungsten has been reduced from 70 cents for the plain bulb and 75 cents for the frosted bulb to 65 cents and 70 cents respectively. A reduction of 10 cents a lamp is made on the 40-watt, 60-watt, 100-watt and 150-watt tungstens, both plain and frosted bulbs, and the 250-watt tungsten lamps, previously listed at $3 for the plain and $3.20 for the frosted, are now listed at $2.75 for the plain and $2.95 for the frosted.

It is interesting to note in this connection, also, what the increased efficiency in incandescent lamps to-day actually means when compared with the lamps of other years. For example, a 50-watt incandescent lamp during its life in 1894 gave 3500 cp-hours, as compared with 45,000 cp-hours for a lamp of the same consumption, the improvement in light output being over 1000 per cent.

Reduction in Lighting Rates in Chicago.

A voluntary reduction in the rates for energy for lighting has been announced by the Commonwealth Edison Company of Chicago to go into effect on May 1. On all bills computed from meter readings taken on or after that date the net charge for the primary or maximum portion will be reduced from 12 cents to 11 cents a kw-hour. The low-rate portion will remain at 6 cents a kw-hour net, as heretofore. This reduction will mean a saving of about $350,000 to the public during the next year, according to the company's estimate. It is considered that the reduction in the price of energy for residence lighting will amount to an average of about 5 per cent in the monthly bills.

Convention of the National District Heating Association.

The third annual convention of the National District Heating Association will be held at the Fort Pitt Hotel, Pittsburgh, Pa., June 6-7-8. The program arranged for the convention is as follows: Address, Mr. George W. Wright, Baltimore, Md.; *Investigation on the Transmission of Heat Through Radiating Surfaces,* by Mr. John R. Allen, Ann Arbor, Mich.; *Heating Franchises,* by Mr. A. C. Gillham, Chicago, Ill.; *Result of Measuring Station Load by Venturi and General Electric Meters,* by Mr. F. D. Chambers, Springfield, Ill.; *The Heating and Ventilating Equipment of the City Investing Building, New York City,* by Mr. J. Byers Holbrook; *Superheated Steam,* by Mr. W. E. Dowd, Philadelphia; *Handling Customers,* by Mr. George W. Wright, Baltimore, Md.; *The Preparation of a Rational Rate System,* by Mr. R. D. De Wolf, Rochester, N. Y.; *Best System of Radiation for Economy and Steam Consumption When Fed from a District Heating Station,* by Mr. W. J. Kline, Lockport, N. Y.; *Best System of Radiation for Economy and Steam Consumption When Fed from a Hot-Water System,* by Mr. A. C. Rogers, Toledo, Ohio. In addition to the above papers, reports were presented by the committee on data, the committee on meters and the committee on radiation. On June 7 a visit will be made to the works of the Westinghouse Electric & Manufacturing Company. Excellent entertainment features will also be provided. The secretary of the association is Mr. D. L. Gaskill, Greenville, Ohio.

Entertainment Features of the N. E. L. A. Convention.

The committee on which will devolve the work of entertaining the delegates and guests attending the convention of the National Electric Light Association has already begun its labors. Every one of the lighting companies in Greater New York and the Public Service Electric Company of New Jersey will act as hosts, joining forces to give the convention a taste of the hospitality of the metropolis. On May 29, the opening day of the convention, it is planned to give a promenade concert and reception at the Hotel Astor for which the best musical talent available in New York City will be engaged. The session at which the report of the public policy committee will be presented will be presided over by the President of the United States. Delegates and guests will be enabled to see Coney Island in all its glory, for the season at the seashore begins May 30 and arrangements have been made for a trip to the famous resort. One evening during the week there will be a theater party at the Hippodrome or some other playhouse of equal seating capacity. Those who desire to play golf will find that the sub-committee having this matter in charge has provided splendid links; and devotees of the American game will be treated to a contest between the Brooklyn Edison and the Philadelphia Electric Companies' teams at the American League Park. It is expected that a large delegation will come over by special train from Philadelphia to witness the game and root for the visiting team. A tea will be given for the ladies at either the Hotel Plaza or the Ritz-Carlton and a Bagby concert at the Waldorf-Astoria. In addition there will be automobile trips to interesting points about the city and shopping tours under the guidance of competent chaperons who will also be available for those who desire to attend the theater or attend other social functions. The committee has arranged for the publication of an artistic pamphlet or booklet featuring and illustrating the points of electrical interest in the city. In addition there will be an exhibition of the high-pressure fire service of New York City, the pumps for which are driven by electric motors supplied with energy from the local lighting companies. As a grand finale to the convention a steamboat excursion will be provided on the last day. All of the entertainment features will be looked after by sub-com-

mittees under the direction of the general committee, which is made up as follows: Mr. Arthur Williams, New York Edison Company, chairman; and Messrs. Dudley Farrand, Public Service Electric Company, Newark, N. J.; Frank W. Smith, United Electric Light & Power Company, New York; T. Beran, General Electric Company, New York; C. G. M. Thomas, New York & Queens Electric Light & Power Company, Long Island City; W. S. Rugg, Westinghouse Electric & Manufacturing Company, New York City; J. W. Lieb, Jr., New York Edison Company; Carleton Macy, Queens Borough Gas & Electric Company, New York; J. E. Phillips, Richmond Light & Railway Company, New Brighton, Staten Island; H. E. McGowan, Flatbush Gas Company, Brooklyn; E. H. Rosenquest, Bronx Gas & Electric Company, Bronx; W. F. Wells, Edison Electric Illuminating Company of Brooklyn; F. A. Stratton, Westchester Lighting Company, Mount Vernon, N. Y.; G. F. Parker, New York Edison Company; F. C. Bates, General Electric Company, New York; H. M. Edwards, New York Edison Company; A. A. Brown, Westinghouse Electric & Manufacturing Company, New York City; Gano S. Dunn, Crocker-Wheeler Company, Ampere, N. J.; L. A. Coleman, United Electric Light & Power Company, New York City; C. W. Price, Electrical Review Publishing Company, New York, and Hugh M. Wilson, McGraw Publishing Company, New York City.

Loss in Electrical Sheet Steel.

The general subject of the meeting of the American Institute of Electrical Engineers held in the Engineering Societies Building, New York, April 14 was the cyclic energy losses in electrical sheet steel. A paper entitled "The Effect of Temperature Upon the Hysteresis Loss in Sheet Steel" was presented by Prof. Malcolm MacLaren, of Princeton University, and one entitled "Commercial Testing of Sheet Iron for Hysteresis Loss" was presented by Mr. L. T. Robinson, of Schenectady.

Professor MacLaren described tests made at temperatures ranging from the mean normal room value to about 750 deg. C., at which later temperature the samples were found to become non-magnetic. The samples tested were placed in an electric furnace, the heating chamber of which was built up of layers of asbestos, and the heating element of which consisted of "nicrome" wire. Observations of the loss at various temperatures were made at frequencies of 25 cycles and 60 cycles per second, and the results were then plotted in form of curves between the loss per kilogram and flux density in lines per square centimeter. By means of these curves the eddy-current loss was separated from the hysteresis loss, and curves were derived for showing the change in the hysteresis loss with the change in temperature at constant induction. The results indicated a remarkably small variation in loss throughout the lower temperature ranges. The rate of change in loss with increase in temperature was practically constant up to about 500 deg. C., above which temperature the loss fell rapidly and reached zero value at approximately 750 deg. C. For example, with a certain sample the loss at a density of 1200 lines per square centimeter was about 0.78 watt per kilogram at 50 deg. C., it reached 0.62 watt at 300 deg. C., fell to 0.38 watt at 500 deg. C., and decreased to zero at 750 deg. C. It was found that the variation in hysteresis loss with change in magnetic density at each temperature followed an exponential law, with the exponent being very closely 1.6.

In the paper by Mr. Robinson the general requirements in the commercial testing of sheet iron for hysteresis loss were summarized as follows:

First, the accuracy of the test results should be such that the error obtained will be small in comparison with the unavoidable error in assuming the test sample to represent the actual average quality of the material.

Second, the dimensions, weight and treatment of the sample should be such that the results may represent the average material from which they are taken to as great an extent as is possible.

Third, if without sacrificing unduly other desirable features samples can be used that will be uniform in dimensions, weight and method of preparation with those used by others, such standard samples should be employed.

Fourth, the entire operation of preparing and testing samples and recording results should be quickly accomplished and at minimum expense for material and labor.

Fifth, the testing should not require the services of specially trained experts or the use of delicate special instruments.

Mr. Robinson described two methods for accomplishing the result desired, namely, one involving the use of a ballistic galvanometer and the other the use of a wattmeter. In one of the testing sets described the samples tested were cut in strips 0.5 in. wide by 10 in. long and assembled to a weight of 1 lb., the height of the sample being about 0.75 in. The exciting mmf was furnished by a small motor-generator set driven from a storage battery, so as to produce a frequency of 10 cycles per second. A low value of frequency was chosen in order to reduce the eddy-current loss as much as possible. The current was passed around the sample as in a solenoid with open ends, the magnetic flux returning through the air. The solenoid contained three windings, one to magnetize the sample, one to supply the potential circuit of the testing wattmeter and the third for determining the flux density at the middle of the sample by means of a voltmeter. The author stated that the loss per pound was based on the assumption that the flux surrounded by the coil placed at the center of the sample should bear a ratio of 1.3 to 1, as compared with the value which would be needed for the same loss in a uniformly magnetized sample.

In the second type of apparatus four solenoids were mounted in order to form a rectangular magnetic circuit with open spaces at the corners. In this case the circuit is much more nearly closed than in the former, so that the inequality of distribution of flux along the samples amounts to not more than 8 per cent, and the error due to the inequality in the flux is much less than 1 per cent. The total weight of the iron used in the test according to this arrangement is 10 kg (22 lb.).

The author remarked that the accuracy that can be obtained in testing 1-lb. samples should be considered as subject to a possible variation of 5 per cent from the actual hysteresis loss in any given sample. In the arrangement where the 22-lb. samples are employed the total loss is subject to a variation of not over 2 per cent of the true value. The accuracy obtainable with either arrangement was considered to be well within the limits of the ability of the producers of sheet steel to secure uniformity of product and of designers to produce definite results with material of uniform and known quality. Concerning the cost of testing, the author stated that, including the cost of the material, the expense per sample tested would be from ten to twenty times as great with the 22-lb. arrangement as it would with the 1-lb arrangement. He expressed the belief that the small-sample arrangement is eminently suited to such situations as require a very large number of tests and where the cost of labor and material in testing is important.

Discussion.

Dr. Clayton H. Sharp outlined some of the improvements in methods and apparatus for magnetic testing and also some of the difficulties encountered in this class of work. He claimed that there is a pressing need for a universally agreed upon method of testing magnetic material in sheets. Such a method might be prescribed by the standardizing committee of the A. I. E. E. to be used by all who wish to make hysteresis tests.

Dr. Edwin F. Northrup called attention to the decreased iron losses with increase of temperature, and suggested that a prolonged series of tests should be made upon properly insulated transformers operated at, say, 200 deg. C. He expressed the opinion that asbestos-covered wire and some of the new insulating compounds would prove suitable for use at such a temperature.

Mr. J. A. Capp remarked that an experience of about ten years with the apparatus employing a bundle of 10-in. x 5-in. strips proved that when a line of machines has been designed

using material which has been tested in this apparatus the test data obtained from such machines may be used to determine the core loss of machines of new designs. By reason of the speed with which results may be obtained and the comparatively small weight of material required, considerable commercial use is being made of this testing outfit.

Mr. Lewis Chubb claimed that better results can be obtained with samples which are heavier than the 1-lb. samples and lighter than the 10-kg samples, namely, samples weighing about 15 lb. and having dimensions of 15.5 in. x 1 3/16 in.

Mr. B. R. Treat said that the 1-lb. apparatus is economical only for those who require many tests per week. Where few tests are required per week the 10-kg apparatus is the more economical, because of the use of commercial testing instruments.

Mr. W. J. Woodbridge said that the eddy-current loss in silicon steel sheets cannot be calculated from the known value of the specific resistance and the thickness of the sheet.

Dr. W. R. Whitney in a written communication claimed that it is desirable to employ as small samples as possible for test, because heat treatments, compression, bending experiments, etc., can be performed on them more easily than on large samples. One-pound samples are small enough so that care and storage of them are not serious matters, while even the cost of samples is a factor with the 10-kg apparatus.

Mr. Carl J. Fechheimer said that although the constants derived from the tests of samples can be used directly in transformer design, they cannot be used in the design of armature teeth and cores, by reason of the non-uniform flux density.

Photometry and Sign Lighting.

At a meeting of the New York Section of the Illuminating Engineering Society held on April 13 the plan inaugurated several months ago of having papers on both theoretical and practical subjects was carried out. Two of the papers were of a technical nature, dealing with photometric relations, and the third paper was one covering the practical subject of sign lighting, being the first paper on this subject thus far presented before the Illuminating Engineering Society.

In a paper entitled "The Photometry of Mercury Vapor Lamps" Dr. Joseph C. Pole described at considerable length the photometric relations concerning straight light-lines. In formulating his equations he assumed that the law of inverse squares and the cosine law were applicable. He deduced equations for showing the illumination produced on a plane parallel to the light-line and on a cylinder concentric with the light-line and a sphere concentric with the light-line. He made the surprising statement that "the proposition of determining the total luminous flux of a light-line, in distinction to point sources of light, is an indeterminate problem if the surface inclosing the light-line for which the luminous flux is to be calculated be not simultaneously defined." However, he showed that in the case of a concentric sphere of infinite radius the total flux produced by a light-line of the character assumed was equal to the quantity $\pi^2 JL$, where J is the apparent "radial candle-power" per centimeter of length and L is the length of the light-line. Dr. Pole used this value of candle-power as his unit in photometric dimensions. The mean spherical reduction factor of a candle-power thus defined is 78.54 per cent. Dr. Pole described tests for luminous output made upon mercury-vapor lamps operated at various current values. In photometering the lamp a section of the tube was isolated by screens, so as to become the equivalent of a point source of light when photometered in a radial direction.

Mr. Bassett Jones, Jr., presented a paper entitled "Polar Curves of Finite Line and Surface Light Sources." The author deduced certain photometric relations and showed by means of these and also by test data that, in so far as the surface source can be considered as perfectly diffusing, the apparent polar candle-power curve becomes the arc of a circle when photometered at a distance from the source large in comparison to the maximum dimensions of the source.

In a paper on "Sign Lighting" Mr. O. P. Anderson described a large number of signs of various types and explained the operation of the flashers used with talking and signs of similar character. He described the methods now in use for utilizing low-voltage sign lamps on high-voltage circuits, which are particularly advantageous when tungsten lamps are employed. He expressed the opinion that when tungsten lamps are used it is not economical to "flash" less than ten lamps at one time, on account of the necessity for connecting at least that many lamps in series at commercial operating voltages. On this account where spectacular effects are to be produced it is often necessary to employ carbon lamps. In comparison with carbon lamps the tungsten lamp possesses an advantageous characteristic in reaching its full brilliancy in approximately 0.04 second, as compared with at least 0.26 second with the carbon lamp.

Discussion.

Dr. K. Norden, in discussing Dr. Pole's paper, claimed that a mercury-vapor lamp can be treated as a point source of light, and photometered on this basis, when the distance between the photometric screen and the lamp is not less than 2.5 times the maximum dimension of the lamp.

Mr. S. W. Ashe stated that when a commercial form of mercury-vapor lamp is photometered at a distance of not less than 20 ft. the average of measurements made in three directions can be considered as a proper basis upon which to calculate the mean spherical candle-power of the lamp. Tests of this nature have shown that the total number of lumens given by a lamp is constant, independent of the distance, although the apparent value of the lumens would vary considerably when photometering a lamp at a shorter distance.

Dr. A. S. McAllister called attention to the fact that a mathematical line may be considered as having a cylindrical surface of infinitesimal diameter, or as composed of an infinite number of point sources. The calculations relating to these different types of sources are not identical, although when applied to any practical lamp the results obtained do not differ greatly. He expressed the opinion that the mercury-vapor lamp corresponds more nearly to a line source made up of an infinite number of points than it does to a source of the cylindrical surface type.

Mr. A. A. Wohlauer derived some formulas for showing the photometric relations involved in plain circular surface sources, and claimed that similar conclusions can be derived for line sources.

Mr. Bassett Jones, Jr., called attention to the fact that the statement by Dr. Pole relating to the variation in the total luminous flux according to the shape and size of the inclosing surface is either incorrect in itself, in being contrary to the law of conservation, or does not properly express the thought which the author had in mind. He contended that although the equations might show a variation in the total flux there is no actual variation in the flux and the apparent variation is due either to inaccuracies in the calculations or to lack of accurate physical significance to the quantity designated as the total flux.

In discussing Mr. Anderson's paper Mr. A. J. Marshall remarked that the slowness of the carbon lamp in reaching its full brilliancy can be overcome by selecting for a flasher installation lamps rated at somewhat less than the voltage at which they will be operated.

Mr. A. A. Wohlauer described various types of reflectors which can be employed in billboard illumination, and remarked that much of the work connected with the design of signs involves strictly illuminating engineering, rather than purely electrical engineering.

Mr. A. L. Powell explained that when colored lamps are used with signs it is found that the life of the lamp depends to a slight extent upon the color of the bulb. This variation he attributed to absorption, and stated in this connection that the life of the blue lamp is less than that of a red lamp, on account of the extra absorption of the former.

In closing the discussion Mr. Anderson remarked that in connection with the use of specially designed reflectors for billboard illumination one of the most difficult features resides in

the accumulation of dust upon the reflector surface. Even with the simplest form of reflector used in the most advantageous position a cleaning once a week is highly desirable.

The secretary announced that at the meeting of the section to be held on May 12 a paper relating to the psychology of light will be read by Professor Woodworth, of Columbia University. On June 8 Mr. S. W. Ashe will read two papers, one of which will deal with the comparison of illuminants and the other with the training of students in illuminating engineering.

Convention of the Missouri Electric Association.

The fifth annual convention of the Missouri Electric, Gas, Street-Railway and Water-Works Association was opened at the Hotel Jefferson, St. Louis, Thursday morning, April 13, by President R. J. Irvine, of Marshall, with an attendance of about fifty members. The convention was welcomed to St. Louis in a speech by Mayor F. H. Kreismann. Following the reports of the association's secretary, Mr. N. J. Cunningham, of Springfield, a number of new company members were voted into the association, and on motion of Mr. Alten S. Miller, of St. Louis, after discussion by Messrs. C. C. Barnard, George Rosenthal, C. L. Clary, P. A. Bertrand and F. E. Murray, it was voted to construe the existing constitutional membership clause so as to admit representatives of municipal plants previously excluded from the organization.

CENTRIFUGAL PUMPS.

On Thursday afternoon Mr. W. H. Reeves read a paper on "Centrifugal Pumps." Although simple in construction, the engineering design of these pumps, said Mr. Reeves, involves complex considerations. The impeller peripheral speed is governed by the head to be developed, while the conditions of quantity to be delivered and speed of operation must also be satisfied. Centrifugal pumps may be arranged in series or in parallel, increasing the pressure or quantity delivered as desired. They are usually operated at 70-ft. head or less per stage, while turbine pumps, which differ from centrifugal pumps by the addition of diffusion veins, are run at about 100 ft. head per stage. The presence of diffusion veins aids in converting velocity into pressure and avoids the losses due to shock. Acceptance tests for pump units should be made at the contract conditions, the fact that a pump delivers more than its rated output, for example, being no criterion of its efficiency under specified conditions. Pumps can be designed both to deliver nearly constant head over a wide range of volume or a nearly constant volume in spite of pressure variations. Pumps for dry-docks exemplify the latter condition. Bronze is the best material for pumps, since in use it develops least friction and corrosion. For plants above 1000 hp capacity centrifugal boiler-feed pumps can be used to advantage. Such pumps cannot develop excessive pressures much above their rated head, and so require no relief valves. In non-condensing plants such pumps may be motor-driven. In condensing plants, where the feed water is heated by the exhausts from the auxiliaries, the pumps, too, are best driven by a non-condensing steam unit. Mr. Reeves also describes a new centrifugal jet-type condenser. Where office-building elevators are operated hydraulically motor-driven turbine pumps can be used to advantage to develop the required pressure. In the case of the Century Building, St. Louis, cited by Mr. Reeves, steam pumps occupying 230 sq. ft. of space were replaced by a 100-hp motor-driven, high-speed, four-stage turbine pump requiring 32 sq. ft. of space. The six elevators use water at 225 lb. pressure and keep the motor running about 40 per cent of the time, during which it is 75 per cent loaded. For water-works pumping, centrifugal units avoid excessive pressures and water rams. Prof. H. B. Shaw, of the University of Missouri, brought out the point that centrifugal pumps should be rated at their output of maximum efficiency. Mr. H. H. Humphrey, St. Louis, explained objections against submerged pumping from deep wells, declaring that with the proper alignment and support of the long shaft and pumping unit under such conditions good efficiencies were difficult to obtain. Messrs. John Hunter and A. S. Miller, of St. Louis, also discussed the mechanical efficiencies of centrifugal pumps, which range in the vicinity of 70 per cent.

LUBRICATION.

Prof. E. A. Flowers, of the University of Missouri, Columbia, reported to the association progress and results already obtained in a series of experiments he is conducting to study cylinder and bearing lubrication and friction under actual service conditions with various temperatures, pressures and speeds. The interesting results pointed out thus far will be given in a future issue of the *Electrical World*, together with an illustrated account of the apparatus used. The paper was discussed by Messrs. P. A. Bertrand, A. S. Miller, W. W. Humphrey and C. L. Clary.

EMPLOYERS' LIABILITY.

Following this discussion ex-Judge Daniel G. Taylor, of St. Louis, appeared before the association to explain a plan of employees' and public liability insurance conducted on a reciprocal arrangement between the public-service corporations subscribing to it. This plan is designed to avoid the heavy business-getting and administration expenses of the old-line companies, instituting better inspection and better selecting risks and reducing the cost of insurance to member companies.

ILLUMINATION AND STREET LIGHTING.

Following the elaborate banquet at the Hotel Jefferson Thursday evening, tendered to the Missouri Association by the League of Electrical Interests of St. Louis, Mr. W. D'A. Ryan, illuminating engineer for the General Electric Company, delivered an address on "Illumination and Street Lighting," illustrated by several hundred lantern slides. After tracing the development of the earliest crude forms of arc and incandescent lamps, generators and motors, Mr. Ryan discussed the distribution characteristics of the modern illuminants for indoor and street lighting, exhibiting a number of handsome slides. Hand-colored and Lumière-process plates were also shown of the electric aurora and scintillator effects produced by batteries of projector searchlamps at Niagara Falls in 1907 and at New York during the Hudson-Fulton celebration. A number of novel, ingenious and freak lighting schemes proposed at various times were also shown and explained. By an arrangement of lenses images of open-arc, inclosed-arc, magnetite and luminous-arc flames were projected on a screen for comparison, and by the aid of a powerful lantern the gorgeous colors of the diffraction bands in soap-bubbles were magnified on the canvas.

Mr. John F. McGlensey, illuminating engineer for the Union Electric Light & Power Company, St. Louis, gave a practical talk on illumination and the work of his office Friday morning, demonstrating the use and application of various types of reflectors. The St. Louis central-station company offers the services of its expert to householders, contractors, architects, merchants, or any others planning schemes of illumination. This advice is free and involves no obligations of any kind to any customer or electric-fixture maker or dealer. The local problems are individually studied and the best solution offered, the illuminating department having "nothing to sell but satisfaction." Mr. McGlensey preached against glare from unshaded lamps, declaring that the intrinsic brilliancy of the tungsten filament is about 1000 cp per square inch, or half that of the sun itself when on the horizon. By the use of various kinds of extensive, intensive, concentrating, focusing and compound prismatic reflectors, glass and steel shades, etc., he showed how the light flux from any source can be quite accurately controlled for any desired purpose. Mr. P. A. Bertrand suggested that in arranging a double row of lamps on a ceiling the lamps should be placed rather nearer the walls, the total width being divided into five parts, three of which should be between the rows of lamps. This arrangement secures a more uniform intensity of illumination in the room.

ELECTRIC VEHICLE.

Mr. Hermann Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, of St. Louis, read a paper

on "The Electric Vehicle," showing how important a factor in the central-station output battery-charging may become with its heavy off-peak demand. There are now 500 electric vehicles in St. Louis as a result of the stimulation afforded by the central-station company, which operates two exclusively electric garages, one for pleasure vehicles and one for commercial trucks. Mr. Spoehrer exhibited a table showing the demand and consumption of typical electric vehicles compared with other energy-consuming devices. Following his paper Mr. C. E. Michel, electric-vehicle expert for the Union Electric Company, exhibited a number of stereopticon slides showing recent electric-automobile types.

ORNAMENTAL STREET LIGHTING.

Mr. N. J. Cunningham, of Springfield, read a paper on "Ornamental Street Lighting" in which he discussed arch, bracket and curb-post tungsten lighting and flaming-arc lighting, all of which systems are exemplified in Springfield. Often the installation of a single block of ornamental lighting will prove contagious to other business sections, said Mr. Cunningham, but he advised central-station managers to allow merchants or others to initiate the ideas of such special illumination. Where possible the handling of the later operation of the system through a civic association or other third party will avoid arguments and annoyance for the central station. Mr. Cunningham described his own installations, and the subject of ornamental street lighting was further discussed by Prof. H. B. Shaw and Messrs. O. H. Caldwell, P. A. Bertrand and C. L. Clary.

Mr. Samuel Hobson extended to members of the association a cordial invitation to join the Sons of Jove, whose rejuvenation was held that evening.

DISTRICT STEAM HEATING.

Mr. H. C. Kimbrough, of Chicago, read a paper on "District Steam Heating" at the afternoon session, in which he recounted the advantages of steam heat from the customer's viewpoint and cited examples of the profitable income derived by central stations which have installed such systems. The figures quoted in this paper, together with the discussion by Professor Shaw and Mr. Bertrand, will be given later.

GAS MANUFACTURE.

Mr. P. A. Bertrand, of Jefferson City, read a paper comparing the advantages of coal-gas and water-gas manufacture. In concluding he pointed out that for combination plants engaged in generating electricity by steam power the water-gas plant will prove most advantageous on account of the presence of boiler equipment for generating the steam used in water-gas making, and also because of the short-hour operations of the latter process, rendering the plant labor available.

As the guests of the Laclede Gas Company, of St. Louis, members of the association were taken in automobiles to the company's South Side plant, where coal-gas and water-gas equipment is installed for producing 14,000,000 cu. ft. of illuminating gas per day. Modern electrically operated Debroew coal-projecting machines are used to charge the retorts. The crushed coal dropped from overhead bunkers is weighed in overhead hoppers on the motor-driven moving platforms of the projectors. From these hoppers it falls onto rapidly moving belts, the direction of which is suddenly changed by pulleys, so that the coal is projected at high velocity into the open doors of the retorts. In this way 1400 lb. of coal is charged into a retort in one minute. After completing the charging of one retort the projector car moves to the next. The projecting-belt apparatus can be elevated to charge into any of three levels of retort openings. An electrically driven ram is also used for "drawing" the retorts, pushing the incandescent coke through an opening on the opposite side of the oven. The exhaust lines from the various blower and auxiliary engines about the gas plant are led to a 300-kw Westinghouse exhaust-steam turbine-generator set, which furnishes energy for the plant motors and for part of the electrical commercial load of the Laclede Gas Company. This turbine receives steam at about atmospheric pressure, and exhausts into a Le Blanc condenser with a cooling tower, which maintains a 27-in. vacuum.

ELECTION OF OFFICERS.

On Saturday morning, following the report of Mr. H. Spoehrer, chairman of the committee on construction and by-law revision, the Missouri association unanimously elected officers as follows: President, Mr. F. E. Murray, Louisiana; vice-presidents, Messrs. P. A. Bertrand, Jefferson City; J. E. Harsh, Joplin, and C. L. Clary, Sikeston; secretary and treasurer, Mr. N. J. Cunningham. Executive committee: Messrs. R. J. Irvine, Marshall; H. Spoehrer, St. Louis; P. W. Markham; R. Scott, Kansas City, and C. C. Barnard. Advisory committee: Messrs. P. A. Bertrand, W. A. Bixby, Springfield, and Alten S. Miller, St. Louis. Finance committee: Messrs. S. M. Locke, Mexico; H. D. Hibbler, Washington, and R. B. Boyce. Upon the invitation of Mr. J. E. Harsh, of the Empire District Electric Company, at Joplin, Mo., the association voted to hold its next convention in that city.

Mr. F. E. Murray, the newly elected president of the Missouri association, is secretary and superintendent of the Louisiana Light, Power & Traction Company at Louisiana, Mo.

ENTERTAINMENT FEATURES.

The entertainment features of the convention opened Thursday evening with the elaborate banquet at the Hotel Jefferson, which was followed by Mr. W. D'A. Ryan's illustrated address. This affair was tendered the association by the St. Louis League of Electrical Interests, the officers and committees of which took an active personal interest in the entertainment of the delegates throughout the convention. Thursday evening the visiting ladies were entertained at a theater party and on Friday afternoon were taken on an automobile ride through the city. Saturday evening the convention members attended in a body a specially revised bill at a vaudeville house. Friday afternoon they visited the Laclede Gas Company's plant, as already mentioned, and Saturday noon they were the guests of the Union Electric Light & Power Company at its great Ashley Street generating station, where an electrically cooked luncheon was served. Saturday afternoon the delegates inspected the St. Louis water-works and sedimentation beds at Chain-of-Rocks on the Mississippi River.

Corporation Commission of Oklahoma.

Mr. George P. Player, telephone engineer of the Corporation Commission of Oklahoma, was a guest at a recent meeting of the Electric Club of Chicago and by invitation spoke briefly of the work of the commission. This commission, which supervises the public-service corporations of Oklahoma, was established about three years ago. It tried at first to investigate the conditions demanding its attention without technical assistance, but it was found necessary to secure trained men to advise it in the large proportion of questions requiring its attention which involved technical considerations. The commission is ascertaining the cost and the replacement cost of the properties of all public-service corporations. It has issued an order requiring these companies to make sworn reports giving the cost of all parts of their plants. To ascertain the replacement cost it is necessary to take an actual inventory of the plant and this the telephone department of the commission has done in several cases.

Referring to the famous Enid telephone case (see *Electrical World* of Jan. 26, 1911, page 214), in which the Supreme Court of the State reversed the commission when the latter ordered the Pioneer Telephone & Telegraph Company not to make a proposed increase in rates, Mr. Player said that the Attorney General has asked for a rehearing and hopes that if this is granted the Corporation Commission will fare better. The growth of the telephone business in Oklahoma is very marked, it having been about 30 per cent in the last year and a half. The Bell company has lines over nearly the entire State and operates 117 exchanges. The use of the telephone is very general and the telephone traffic in the principal cities is particularly heavy in comparison with the number of stations. In

conclusion the speaker said that the Corporation Commission of Oklahoma is trying to help the companies as well as the consumers and is becoming somewhat more conservative as it measures the magnitude of its task. It is no doubt the hope of the commission that it will serve eventually as a board of arbitration between the public-utility corporations and the people.

Discussion of Commission Regulation in Chicago.

Alderman W. J. Pringle, chairman of the Chicago City Council committee on gas, oil and electric light, was the first speaker at the meeting of the Electric Club of Chicago on April 5, which was devoted to a discussion of the proposed commission regulation of public-service utilities in the State of Illinois. The alderman gave an account of the public-service commissions of Wisconsin, New York and Massachusetts, and remarked that in the last-named State it is proposed to consolidate a number of existing commissions into two, one to have jurisdiction over Boston and the other over the remainder of the State. Personally, the speaker does not think it material whether there are one, two or more commissions in Illinois. The public-service corporations in Chicago, at present dealt with by the City Council, are of great magnitude and might better be under the supervision of a commission of trained men. In the relation of the public-utility corporations and the public many important questions came up, such as valuation of plants, depreciation, proper return to stockholders, methods of operation, amount of capitalization, going value, rates and complaints. There are two sides to each of these questions, and their equitable adjustment requires the best efforts of highly trained specialists.

In relation to the half dozen or more bills pending at Springfield proposing the creation of public-service commissions, Alderman Pringle made the interesting statement that he did not look for any legislation at this time. However, one or more public-service commissions are sure to come in Illinois, and the question should be widely discussed so that the people may be educated. The municipal authorities who have control of these questions now are naturally loth to relinquish that control for political reasons. None the less, the question of regulation of public utilities should not be a question of politics, but one of political economy. In relation to rates, the alderman said that it was obvious that efficient service was not apt to be continued for any length of time unless a fair price is paid for that service. He thinks the companies themselves should favor the commission idea. The public-utility field is to be considered as a natural monopoly to be regulated by government. The corporations must be assured of a long tenure of operation if held down to a low rate.

Mr. George Weston, representing the City of Chicago on the Board of Supervising Engineers, Chicago Traction, gave a summary of the work of this board in supervising the rehabilitation and operation of the surface street-railway systems in Chicago. He expressed the opinion that public-service commissions will generally reach a more satisfactory conclusion if there is one commission to deal with each class of utilities rather than a general commission having supervision of gas, electric light, street-railway, telephone, water-works and other utilities. The Board of Supervising Engineers is composed of men who have made electric traction a life study, and its work has been beneficial. It is composed of one member representing the city, another representing the company affected and a third who is the chairman and umpire. This arrangement has been very satisfactory and it leads Mr. Weston to think that the companies interested might very well be represented on the proposed State commissions. The speaker made a plea for practical, qualified, experienced men on the public-utility commission rather than a board composed of lawyers exclusively. In making appraisals, for instance, it is of great importance that the work should be done by men who have practical knowledge of the plant under valuation and how it is used in actual service.

Mr. Frank F. Fowle, consulting engineer, who drew up the Brown bill pending in the Illinois Senate, was next called upon. He said that about one-third of the states of the Union have public regulation in some form, and claimed that both the public and the utilities must be protected. The right of petition should be given to both, and rates should not be either unreasonably high or unreasonably low. Mr. Fowle praised the Wisconsin law and the manner in which it is administered. In that State rates are fixed absolutely, whereas in New York only the maximum rates are determined. In the Brown bill one single state-wide commission is proposed for Illinois. The experience of New York, where there are two commissions and where an inquiry is now in progress in relation to the great expense of conducting the New York City commission, seems to show that one state-wide commission is preferable on the score of economy at least. There are other arguments in favor of the single commission, and the speaker enumerated several. For instance, a single commission will not have its jurisdiction divided in any case by geographical boundaries. It will be subject in the least degree to local political influence, and there will be no divided jurisdiction in case of companies giving various classes of service, as, for instance, is the case with a combined electric light and street-railway company.

Public Service Commission Law in State of Washington.

An act creating a Public Service Commission was approved by the Governor of the State of Washington on March 18. It makes the valuation of the property of every service company mandatory upon the commission. The members of the Railroad Commission constitute the first Public Service Commission. The most important provisions affecting electrical, telephone and telegraph companies are summarized below.

All charges made by gas, electric and water companies shall be just, fair, reasonable and sufficient. Every company shall supply such service, instrumentalities and facilities as shall be safe, adequate and efficient. Every company shall file with the commission, and shall print and keep open to public inspection, schedules in such form as the commission may prescribe showing all rates and charges and all general privileges and facilities. No change shall be made in any rate or charge, or any form of contract, or in any general privilege or facility, except after thirty days' notice and publication. For good cause, however, the commission may allow changes without this notice. No company shall charge any different compensation for any service than that indicated in the schedule, except that its product may be furnished at free or reduced rates to employees and their families, and officers, attorneys and agents, as well as to charitable institutions. No company shall grant any undue or unreasonable preferences or unjust discrimination, but there is no prohibition against a sliding scale of charges permitting a greater charge per unit for a less than for a greater quantity. Nothing in the act shall be construed to prevent the company from continuing to furnish its product or service at the rates fixed in any contract that may be in force when the act takes effect or on the effective date of any schedule filed subsequently. However, the commission shall have power in its discretion to direct by order that electrical contracts shall be terminated.

All rates of telephone and telegraph lines are to be fair, just, reasonable and sufficient, and all facilities, instrumentalities and equipment are to be safe, modern, adequate and to be kept in good condition and repair. Schedules shall be filed with the commission and printed and kept open to public inspection. No change shall be made in rates except after thirty days' notice, but for good cause the commission may allow changes without this notice. Regular and uniform charges to all persons and corporations under like circumstances for like or

substantially similar service shall be extended. No free or reduced service shall be given, except to officers, employees, agents and others connected with the companies and their families, and charitable and religious institutions, etc. There shall be no unreasonable preferences. Existing contracts shall be carried out, except that the commission shall have power in its discretion to direct by order that they shall be terminated. No company shall charge any greater compensation in the aggregate for the transmission of a long-distance message of like kind for a shorter than for a longer distance over the same line in the same direction within the State, the shorter being included within the longer distance, or charge any greater compensation for a through service than the aggregate of the intermediate rates. This shall not be construed as authorizing any company to charge as great a compensation for a shorter as for a longer distance. The commission may authorize a less charge for a longer than for a shorter distance service in special cases after investigation. Every company shall receive, transmit and deliver without discrimination or delay the message of any other telephone or telegraph company.

Whenever after a hearing upon its own motion or upon complaint the commission shall find that rates or practices are unjust, unreasonable and unjustly discriminatory or unduly preferential, or in any wise in violation of the law, or that they are insufficient to yield a reasonable compensation for the service rendered, it shall order just, reasonable or sufficient rates. Whenever it shall find after a hearing that the efficiency of electric-lamp supply or the voltage of the energy supplied for lamps or motors is inadequate, it shall order such improvement as will be just and reasonable. Whenever the rules, regulations, measurements or standard thereof are unjust, unreasonable or inadequate, or any service which may be reasonably demanded is not furnished, it shall fix reasonable rules by order. Whenever it shall find after a hearing that repairs or improvements ought to be made, or that any additions or extensions should reasonably be made, either for the convenience or security of the public and employees or to secure adequate service, it may order that they be made. It may order physical connections and joint rates between two or more telephone or telegraph companies and may appoint inspectors of electric meters. No company shall put in use any meters the type of which shall not have been approved by the commission. Every such company shall prepare such forms, apparatus and facilities as may be required by the commission for testing meters. The commission shall have meters tested on complaint of consumers. If an electric meter is more than 4 per cent defective to the prejudice of the consumer the expense shall be borne by the company, otherwise the expense shall be borne by the consumer. The commission shall fix rates for the testing of meters.

The commission shall have the right at any time to inspect accounts, books, papers and documents of any public-service company. Every company shall furnish annually to the commission a report in such form as the commission may require. The commission may in its discretion prescribe the forms of all accounts, records and memoranda to be kept. No complaint as to the unreasonableness of rates shall be entertained except upon the motion of the commission, unless the same be signed by the mayor, council or commission of the community affected, or not less than twenty-five consumers. Any complainant or company affected by an order of the commission, deeming it contrary to law, may apply to the Superior Court of the county in which the proceeding was instituted for a writ of review within thirty days after the service of the order for the purpose of having its reasonableness and lawfulness determined. After the entry of judgment in the Superior Court, the commission or any public-service company or complainant may appeal to the Supreme Court of the State.

The section relating to the valuation of property provides that the commission shall ascertain the cost of construction and equipment, the amount expended in permanent improvements and the proportionate amount of such permanent improvements charged in construction and operating expenses respectively, the present as compared with the original cost of construction and the cost of reproduction of the property of every public-service company. It shall ascertain the total market value of the securities and of the property of every public-service company, the time intervening between the expenditure of money in the cost of construction and the time when dividend returns were first received, the probable earning capacity of each company under the rates now charged and the sum required to meet fixed charges and operating expenses, the density of traffic and population, whether the expenditures already made by any company in procuring the property were such as were justified by the existing conditions and such as might reasonably be expected in the future, and whether the money expended had been reasonable for the present needs of the company and for such needs as may reasonably be expected in the immediate future. Hearings are to be held for the purpose of ascertaining the value of such properties. The commission shall render findings of fact in writing concerning all matters respecting value. Any company affected may institute proceedings in the Superior Court of the county, if it believes such findings to be contrary to law or the evidence introduced, and decisions of that court may be appealed to the Supreme Court of the State. Nothing less than the market value determined by the commission shall be taken as the value for taxation. Further hearings shall be held from time to time for the purpose of ascertaining the betterments and additions made by any company subsequent to the date of prior hearings.

If the commission is of the opinion that any company is failing or omitting, or is about to fail or omit to do anything required of it by law or order of the commission, it shall direct the Attorney General to commence an action for the purpose of having such violations or threatened violations prevented. Every public-service company which shall violate any provision of the act or any order of the commission shall be subject to a penalty of not to exceed $1,000 for each offense. Every officer, agent or employee who shall violate any provision of the act or any order of the commission or aid in such violation shall be guilty of a gross misdemeanor. Similar penalties are provided for corporations and persons other than those engaged in public-utility service. Nothing in the act shall authorize the commission to make any order affecting rates or facilities of any street railroad, telephone line, gas plant, electrical plant or water system owned and operated by any city or town. The sum of $118,146 is provided for carrying out the provisions of the act.

Annual Report of New Jersey Public Service Corporation.

The annual report of the Public Service Corporation of New Jersey for the year ended Dec. 31, 1910, shows that of the $27,672,846 gross earnings of leased and controlled companies $5,872,238, or 21.2 per cent, was received from the electric properties. The railway properties contributed $13,308,726 and the gas properties $8,491,882. In addition to these totals the corporation received as income from securities pledged and from miscellaneous sources $1,532,347. The revenue of the controlled electric properties showed an increase of $754,510, or 14.7 per cent, over the preceding year. During the seven months of the existence of the corporation in 1903 the revenues of the electric properties were $1,776,558. In the full year 1904 they were $3,502,812. Increases over the preceding year have been shown in each year with the exception of 1908.

Under the plan of organization of the company the subsidiary properties of different classes of utilities are operated by the Public Service Railway, the Public Service Gas Company and the Public Service Electric Company. The latter was the last one of the three companies to be formed. It was organized on June 13, 1910, and, except directors' qualifying shares, all the stock is owned by the corporation. The leases of electric properties held by the corporation were assigned to the new company, which also leased the power plants and substations of the railway company. During the year the entire capital stock of the Burlington Electric Light & Power Company and 90.2

per cent of the capital stock of the Princeton Light, Heat & Power Company were acquired.

The general mortgage 5 per cent bonds of the company were listed upon the New York Stock Exchange, and since the close of the calendar year the capital stock has also been listed. On Oct. 1 the corporation sold $4,000,000 of 5 per cent three-year collateral notes for the purpose of raising funds to pay the cost in part of betterments and extensions. The improvements completed during the year include a substantial addition to the Marion electric generating station. The corporation has moved into its new office building in Newark, where a lunchroom has been provided and lunches are furnished daily to 600 employees of the corporation without cost to them. An insurance, sick-benefit and pension fund was established on Jan. 1, 1911. Mr. Thomas N. McCarter, president of the corporation, says that it is estimated that the application of this system will cost the corporation approximately $50,000 annually for the first few years and more thereafter. Regarding the Board of Public Utility Commissioners of New Jersey he says that it is a pleasure to say that the commissioners have entered upon their duties seriously and with a due regard to the importance of the interests to be supervised by them, and that the relations of the companies owned by the corporations with the commission have been and are both cordial and agreeable.

Capital charges on account of the electric system aggregated $2,111,737 during the year. The balance sheet of the Public Service Electric Company as of Dec. 31, 1910, shows the cost of plant, real estate and property as $6,877,443, and investments of $207,843. The capital stock of this company outstanding at the end of the year aggregated $6,750,000, and there were mortgages payable of $261,750. The sum of $900,000 advanced by the corporation has been paid since by the issue of stock. The development of the electric business is shown by the accompanying statement. The increases are affected somewhat, but not materially, by properties acquired between June 1, 1903, and Jan. 1, 1911. The total of kw-hours sold has increased from 48,894,308 in 1905 to 89,742,689 in 1910. The number of customers increased from 18,262 at the close of 1903 to 62,539 in 1910. The number of street arc lamps supplied in 1903 was 7745, and this increased by 1910 to 11,441. The number of street incandescent lamps supplied increased from 5733 in 1903 to 16,640 in 1910. The total connected load in kilowatts increased from 45,380 in 1903 to 137,058 in 1910. The company furnishes electric service to 152 municipalities, with a total population of 1,898,059.

TABLE I—ELECTRIC STATIONS.

	June 1, 1903.	Dec. 31, 1910.
Number of generating stations	14	28
Number of boilers	113	219
Number of generators	156	189
Capacity of generators in kilowatts	40,075	124,158
Number of substations	9	42
Number of rotaries	12	73
Capacity of rotaries in kilowatts	5,400	50,200
Kw-hours produced (years 1903 and 1910)	129,614,180	288,740,147

TABLE II—ELECTRIC CONDUITS AND TRANSMISSION LINES. (RAILWAY AND LIGHTING COMBINED.)

	June 1, 1903.	Dec. 31, 1910.
Length of transmission lines (in miles)	47	374
Length of conduits (in street miles)	25	79

TABLE III—ELECTRIC DISTRIBUTION SYSTEM STATISTICS.

	June 1, 1903.	Dec. 31, 1910.
Number of poles	45,059	97,825
Miles of wire	4,244	9,686
Number of transformers	5,336	12,500
Number of meters	16,000	63,186
Number of customers	16,190	62,539
Number of street arc lamps	7,415	11,441
Number of street incandescent lamps	5,517	16,640
Total commercial load connected (in 50-watt equivalent)	710,000	2,613,236

New York Commission News.

The New York Public Service Commission, Second District, has authorized the Poughkeepsie Light, Heat & Power Company, the Newburgh Light, Heat & Power Company and the Hudson Counties Gas & Electric Company to consolidate in a new corporation under the name of the Central Hudson Gas & Electric Company.

The decision is an important one, indicating as it does various tests applied by the commission in consolidaton cases, including the valuation of the properties involved. The opinion in the case was written by Commissioner Martin S. Decker, and among the findings and rulings are the following:

1. That two of the companies operate in practically common territory and the other company in territory adjoining and connected with the others by a transmission system.

2. That the stocks of the three companies are in great bulk held by a common interest, and that the management of all is practically the same.

3. That the corporate relations of these companies have become interconnected and interdependent with common control requisite under contract relations and reciprocal supply of electric energy, and larger economies in management, administration, production and financing would result from consolidation.

4. That each of the companies is in good condition financially and none of the properties is in such condition physically or financially that it would diminish the ability of the consolidated company to give full and adequate service at reasonable rates.

5. That the common capital stock of each company may be properly exchanged share for share for stock of the consolidated company.

6. That the value of each of the two larger properties is in its excess of its capitalization and balance of bills and accounts payable over those receivable.

7. That the fixed capital accounts of all three companies have not been sufficiently credited in the past for retirement of property, and have been charged with replacements under the accounting system employed prior to the prescription of the uniform accounting system by this commission.

8. That examinations by the commission's engineer and special accounting examiner indicate that considerable amounts should be written off from the fixed capital account of each company and that other accounting changes should be made, which are indicated in balance sheets given in detail and consolidated herein for purposes of the case.

9. That necessity for revision of the accounts is demonstrated by the fact that it would be practically impossible to require such revision after a consolidation.

The commission holds that the consolidation should be approved subject to agreement that the balance sheet stated by the commission shall constitute the basis of opening entries on the books of the new or consolidated company and that the new company shall have made under direction of the commission an inventory and appraisal of the permanent assets to be included in the "fixed capital account" according to rules stated, such inventory and appraisal after approval by the commission to be the basis for correcting the books of the corporation as to the accounts for fixed capital. It holds that the new company should be required to maintain separate accounts of its business as to each locality served, showing property employed, income received and expenses incurred, and that certain unissued bonds now held by two of the applicant corporations should be canceled.

The commission has authorized the Niagara Falls Power Company to issue 262 shares of its capital stock, par value

$26,200, and to apply the proceeds of 229 shares heretofore authorized toward the purchase of 491 shares of the stock of the Tonawanda Power Company. The Niagara Falls Company now owns 2009 of the 2500 shares of the capital stock of the Tonawanda Power Company and purposes to acquire the entire capital stock. The company proposes to pay from income the remaining $22,000 principal amount necessary to accomplish the transaction.

The commission has denied the petition of certain residents of Dunkirk and Fredonia asking for a reduction of fare on the Buffalo & Lake Erie Traction Company's lines between Dunkirk and Fredonia. The present rate is 10 cents, with full transfer privileges in both Dunkirk and Fredonia. By reason of the transfer facilities a passenger is now enabled to ride from the furthest transfer point in Dunkirk to the furthest transfer point in Fredonia, a distance of at least 3.5 miles. Further, the company now issues a book of tickets allowing all the privileges of single fare, twenty-four rides, for the sum of $1.25, making a ticket charge of approximately 5¼ cents a trip. The commission believes that the company is, under all the circumstances, charging a reasonable and just fare.

Massachusetts Legislative News.

At an executive committee session last week at Boston Mr. John H. McArthur, of the firm of McArthur Brothers, New York, stated that interests identified with his firm compose the principal financial backing of the Boston & Eastern Electric Railroad Company, which has for several years been endeavoring to secure permission from the Massachusetts Railroad Commission to build a high-speed electric interurban railroad between Boston and the North Shore district. It is expected that the committee on railroads and metropolitan affairs, which has the matter in charge, will shortly submit its conclusions to the Legislature upon the Boston & Eastern bill, which requires the Railroad Commission to issue a certificate of exigency to the company. The question of financial backing has been at the storm center ever since the promoters of the Boston & Eastern Company began their campaign. One of the main contentions of the existing steam and electric railways in the territory has been that the Boston & Eastern plans have not represented a bona fide transportation project. At the above hearing it developed that the company has already assembled about $250,000, and it is known that approximately $125,000 has thus far been expended in engineering and legal services. The feeling is strong in eastern Massachusetts that the time has come for the Boston & Eastern question to be settled. The plans of the organization have been prepared under the electric railroad law of 1906, and no road whose petition has been brought before the Railroad Commission in recent years has received such thorough investigation from the technical point of view. Thus far not a single road has been built under the law of 1906, although the Boston & Providence and Boston & Western companies have received certificates from the commission, and it is expected that construction will be inaugurated in the near future. The chief obstacle to the plans of the Boston & Eastern company is the bill of the New York, New Haven & Hartford Railroad providing for the construction of a tunnel under Boston Harbor, with the establishment of electrified service as a result between Readville and Beverly. No decision has thus far been reached in committee regarding this bill, but matters are rapidly coming to a head.

Opposition to legislation requiring electrification was presented at a hearing last week before the committee on railroads and metropolitan affairs. Mr. J. H. Heustis, general manager of the Boston & Albany Railroad, argued at length that the smoke nuisance has been so much reduced in the Boston suburban district that electricity is not needed on the grounds of cleanliness. He also contended that fares charged suburban traffic would have to be increased 40 per cent if electricity should be adopted between Boston and South Framingham, and stated that the Boston & Albany cannot at present afford to make the change. Mr. Woodward Hudson, counsel for the Boston & Albany Railroad, urged the Legislature to avoid any sweeping action relative to electrification, and said that nothing should be required on the Albany line until electrified service can be worked out on the New Haven company's Readville-Boston service. Mr. William H. Coolidge, counsel for the New Haven interests, also argued that the harbor tunnel electrification should first be effected, and that the cost of electrifying all the lines in the Boston district should not be laid upon the companies in a single act.

Massachusetts Commission News.

A ruling was made by the Massachusetts Gas & Electric Light Commission at a hearing in Haverhill on April 6 in connection with the petition of the Haverhill Gas Company for approval of an issue of new capital stock to the amount of $900,000, the proceeds to be used in the purchase of the Haverhill Gas Light Company's property and franchise. It was contended on behalf of the Municipal Council that the petitioner cannot lawfully apply the proceeds of new capital stock to the purchase of the property of the Haverhill Gas Light Company, for the reason that both the statute and the common law forbid the latter company to dispose of all its property without special legislative authority. The ruling of the board upon this point was as follows: "If the contention of counsel for the city is correct, such conveyance will be void because it is contrary to the statute prohibiting a gas company from transferring its franchise and because of the established common-law principle that a public-service corporation cannot so dispose of its property as to take away its power to perform its public duties. The determination of this board can make such conveyance neither valid nor invalid. That question is for the courts; it is not necessary that the board should attempt to determine it. It is the opinion of the board, however, that the question raised and the transaction to which it relates are of such importance, and that the legality of such a conveyance by the old company to the new is open to such serious doubt, that the board ought not to approve an issue of stock for such a purpose until either the conveyance has actually been made or its legality has been determined by some judicial tribunal."

Maryland Commission News.

The Maryland Public Service Commission has issued an order authorizing the issue of $111,000 of bonds by the Baltimore County Water & Electric Company to defray the expense of extensions, construction and improvements. It also authorized the sale of $100,000 worth of the bonds for immediate use, the other $11,000 to be held as a sinking fund.

Governor Crothers last week approved the Public Service Commission's appointments of extra inspectors to assist Chief Engineer Phelps in his general investigation of the physical conditions of all public utilities throughout the State in compliance with a recent order of the commission. They are as follows: Steam railroads, Mr. John D. Riley; electric roads, Mr. C. G. Edwards; gas works, Mr. L. A. Langham; wharves and piers, Mr. W. A. McDonough; in charge of tabulations, Mr. I. F. Howard. The list is composed entirely of Marylanders, who will work under Mr. Phelps' general supervision. They will be assisted in their investigation by the regular force of inspectors in the chief engineer's department.

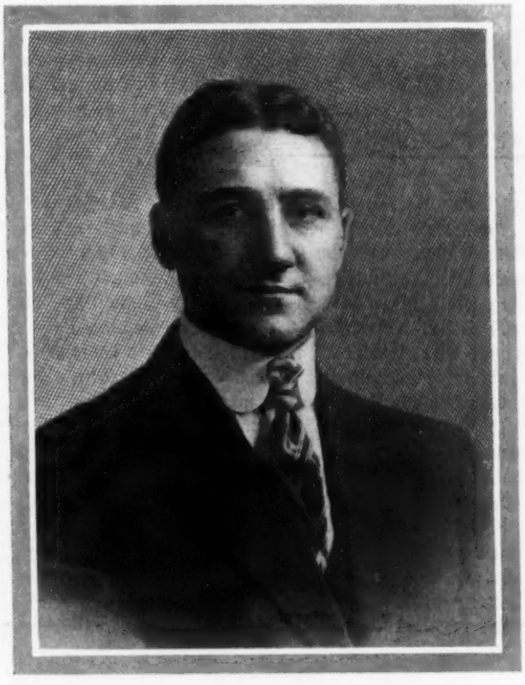
City Solicitor Poe has stated that it will be some time before he completes gathering data so that he can submit to the commission the petition of the city of Baltimore urging that the price of electric energy be reduced. Mr. Poe has encountered the same difficulty which Superintendent of Lamps and Lighting McCuen encountered when the electric company refused to supply him with some figures which he desired. It is not expected that the company will supply the data desired until the case comes before the commission, which can require it to show its books.

AMERICAN ELECTRICAL ENGINEERS.—XXX.

J. W. Esterline.

Mr. John Walter Esterline was born at Fort Wayne, Ind., Nov. 13, 1874. Entering Fort Wayne College at the age of sixteen to prepare to take up the study of law, he became interested in scientific subjects and changed his earlier intentions in favor of engineering. After completing a preparatory course of four years, he entered on the electrical course of Purdue University, Lafayette, Ind., in 1893, and was graduated in 1897.

For six years following graduation Mr. Esterline was in charge of the students' work in the experimental laboratory at Purdue University, meanwhile supervising the construction of extensive additions to the building and apparatus, and assisting in assembling and conducting the National Electric Light Association photometric laboratory, in which complete investigations of the inclosed-carbon arc lamp and other illuminants were made. In 1903 Professor Esterline took charge of instruction in design of electrical machinery at Purdue, and for several



J. W. Esterline.

years served as acting head of the department during the illness and following the death of Professor Matthews.

During his connection with the university Professor Esterline employed his vacation periods and spare time in consulting engineering work, and laid the foundation of a business which in 1908 had grown to such an extent that he resigned from the university staff to devote all of his time to his commercial interests, having in the meantime organized a company to manufacture several types of electrical instruments and other electrical apparatus. Since the organization of the Esterline Company Mr. Esterline has devoted a good portion of his time to consulting engineering and to the design of steam and water-power stations, industrial plants and outdoor illumination.

Mr. Esterline is at present consulting engineer for the Wabash River Power Company, developing a water-power plant on a site on the Wabash River; the Crawfordsville Electric Light & Power Company and the Bedford Power Company. The last-named is carrying on extensive work, including the design and construction of a 10,000-kw combined water-power and steam plant and the electrification of the great oölitic-limestone quarrying and milling district of Bedford, Ind.

The Esterline Company is at present manufacturing a complete line of graphic recording meters; an automatic electric lighting equipment for automobiles and motor-boats; an incandescent locomotive head-lamp; a self-setting, reverse-power circuit-breaker for storage-battery charging; permanent magnets for electrical instruments and ignition apparatus, and several types of magnetic-testing equipment. It recently completed steam power plants for the Frankfort Electric Light & Power Company, Logansport Electric Light Company, Indiana State Soldiers' Home, Indiana Institute for the Deaf and Dumb, C. H. Campbell Furniture Company, the McDougall Kitchen Cabinet Company, American Box Ball Company, Indiana Springs Company and the Indiana Hospital for the Insane.

Mr. Esterline is the inventor of several commercial types of magnetic testing machines, and has given much attention to the subject of magnetic materials. His work on "The Design of Electrical Machinery" has now gone through three editions and is used as a textbook in a number of engineering schools.

Mr. Esterline is a member of the American Institute of Electrical Engineers, the American Society for Testing Materials, the American Society for the Promotion of Engineering Education and the Indiana Electric Light Association, and was a member of the Jury of Awards in the department of electricity of the Louisiana Purchase Exposition. From 1899 until he resigned in 1910 he served as chairman of the committee on magnetic materials of the American Society for Testing Materials. Before this society, in 1903, he presented a paper entitled "Direct-Reading Apparatus for Measuring Core Loss," in which were described original methods for measuring core losses in alternating and rotating magnetic fields. In 1905 he read a paper giving specifications for "A Complete Magnetic Testing Laboratory." Before the American Institute of Electrical Engineers in 1903 he presented a paper with Mr. C. E. Reid on "Some Factors Which Affect Energy Losses in Armature Cores."

CURRENT NEWS AND NOTES.

Terminal Electrification in Chicago.—The commission of seventeen city officials, business men and railroad executives appointed by the Chicago Association of Commerce to make a complete investigation of the electrical problem in Chicago has selected a chief engineer to have charge of the work of the commission. The commission has taken permanent headquarters in the building of the People's Gas Light & Coke Company, South Michigan Avenue and East Adams Street.

Nebraska Convention.—The fourth annual convention of the Nebraska Electrical Association (now affiliated with the National Electric Light Association) will be held in the Lindell Hotel, Lincoln, Neb., on April 24, 25 and 26. This convention will follow the Iowa convention at Davenport so closely that it is believed that many visitors, including representatives of manufacturers and supply dealers, will be able to attend both conventions. Mr. B. C. Adams, of Lincoln, is president of the Nebraska association and Mr. S. J. Bell, of David City, is secretary-treasurer.

Technology Congress Closes.—The Congress of Technology at Boston was brought to a close on the evening of April 12 by a dinner at the Technology Union under the auspices of the Electrical Engineering Society of the Massachusetts Institute of Technology. The chief speaker was Mr. Frank J. Sprague, consulting engineer, New York, who gave a talk on "The Romance and Realities of Engineering." The congress celebrated the fiftieth anniversary of the founding of the institute; it was attended by about 1200 alumni, and demonstrated the fact that the places of scientific education and engineering are well assured for the future. Abstracts of the more important papers of electrical interest were printed in last week's issue.

Electricity in Ice Plants.—At a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers to be held at the rooms of the former on April 26 Mr. A. C. Smith, of Buffalo, N. Y., will deliver an address on "Electricity in Ice Plants," with lantern-slide pictures.

Meeting of the Electric Vehicle Association of America.—The regular monthly meeting of the Electric Vehicle Association of America will be held in the Engineering Societies Building, New York City, April 25. The topic for the evening will be "The Ampere-Hour Meter for Electric Vehicles," presented by Mr. R. C. Lanphier, of the Sangamo Electric Company.

Chicago Branch of Institute of Operating Engineers.—A meeting of the Waters Council of the recently organized Institute of Operating Engineers, composed mainly of engineers in charge of isolated plants, was held at the rooms of the Western Society of Engineers in Chicago on April 11. Mr. A. Bement, consulting engineer, gave an illustrated address on "Coal and Its Production in Illinois." Mr. Fleming, of the engineering corps of the Board of Education, was elected chairman of Waters Council.

The Institute of Operating Engineers.—On April 13 Mr. J. C. Jurgensen read a paper entitled "Economic Aspects of the Institute of Operating Engineers" at a meeting of the New York branch of the society in the Engineering Societies Building. On May 11 this branch will hold its second monthly meeting, at which Mr. F. L. Johnson will present a paper entitled "The Necessity of Industrial Education." The Isherwood branch of the Institute was organized on March 25, when Mr. F. L. Johnson was elected chairman and Mr. Frank Martin secretary.

Postponement of Exposition of Inventions.—The International Exposition of Inventions, which was to have been held in the Coliseum at St. Louis April 10 to 15, has been postponed until a date some time later in the summer, probably in August. The purpose of the exposition is explained to be that of providing meritorious but unknown inventors with facilities for exhibiting their productions before the interested public and investors. Patented machines, appliances and processes of all kinds will be shown, a special department being devoted to electrical inventions. The manager in charge of the enterprise is Mr. W. K. Small, 511 New Bank of Commerce Building, St. Louis, Mo.

Pittsburgh A. I. E. E. Banquet.—The annual banquet of the Pittsburgh Section of the American Institute of Electrical Engineers will be held at the Rittenhouse Hotel, Saturday evening, April 22, and a large attendance is anticipated. It will be attended by the members and their wives and friends. Mr. Charles F. Scott, consulting engineer of the Westinghouse Electric & Manufacturing Company, will act as the toastmaster, and his well-known ability as a happy speaker augurs well for the success of the occasion. President D. C. Jackson will be present and respond to a toast. Among the other speakers on the program are Rabbi J. Leonard Levy, Dr. R. K. Duncan, of Pittsburgh, and Col. H. G. Prout, general manager of the Union Switch & Signal Company, Swissvale, Pa.

New Home of Chicago Engineers' Club.—Work is under way on the new seven-story building of the Chicago Engineers' Club at 314 South Federal Street, adjoining the Union League Club. The building occupies a lot 25 ft. wide and 100 ft. deep. The first three floors have been leased to a well-known restaurant, but the banquet-room on the third floor is reserved for the exclusive use of the club from 11 a. m. to 3 p. m. The club headquarters will be on the fourth floor, including reception room, office, checkroom, lounging-room and cardroom. The fifth, sixth and seventh stories are to be divided into bedrooms. The Chicago Engineers' Club was organized eight years ago. It is a social club composed mainly of engineers. The total membership at present is about 340, of whom ninety are non-resident members. Mr. James O. Heyworth is president and Mr. Robert I. Randolph is secretary and treasurer of the club.

N. E. L. A. Convention Arrangements.—The hotel committee of the National Electric Light Association, of which Mr. Frank W. Smith is chairman, is taking the active initiative as to convention work by issuing its circular with regard to hotel provision for the convention, from May 29 to June 2, when the meetings will be held at the Engineering Societies Building, New York. The circular of the committee is quite an elaborate piece of work and includes a list of fifty-four hotels, with their location, telephone number and the fullest details as to accommodations and prices. In addition, this circular, which bears on the outside an admirable vignette of the Engineering Societies Building, embodies also a colored outline map of Manhattan Island, showing the location of this building and of every one of the hotels listed, so that the members can see at a glance the relative distance, convenience, etc., of all the accommodations. The map includes also lines of elevated railroad and subway with the stations indicated. An attendance of 3500 is now expected and virtually assured.

Rate Reduction in St. Louis.—On April 12 Mayor Kreismann, of St. Louis, signed the city ordinance reducing the maximum rate charged by the Union Electric Light & Power Company from 12 cents to 9.5 cents per kw-hour. The bill had already passed the two houses of the City Council and had the approval of the Municipal Public Service Commission. After a thorough investigation of the Union Electric company's business this local commission agreed to the correctness of the representations made by the company regarding its rates and revenues, but nevertheless recommended the passage of the rate-reducing measure. The new law will go into effect six months from the date of signing, and will also operate to reduce the minimum service charge to 50 cents a month. President Alten S. Miller, of the Union Electric company, has expressed no decision as to whether the terms of the ordinance will be contested or complied with. The matter of testing the constitutionality of the new ordinance in the courts was to come up at the regular board of directors' meeting of the company April 19.

Special Train for N. E. L. A. Convention.—Mr. G. A. Freeman, of 120 West Adams Street, Chicago, assistant master of transportation for the National Electric Light Association, announces that arrangements have been made with the New York Central Lines for a special train leaving Chicago on the Lake Shore railroad from the La Salle Street Station on Sunday, May 28, at 2:30 p. m. This train will be known as the "Electric Light Special," and it is intended for the use of visitors to the New York convention of the N. E. L. A. The style of the train will compare favorably with that of the finest train operated by the New York Central Lines, the equipment including drawing-room and compartment car, buffet and library car, compartment and observation car, dining cars and standard Pullman sleepers. The fare from Chicago to New York on this train will be $18.15 (party rate). Visitors from points west of Chicago desiring to travel on this train should consult first their local agent. If they can arrange to purchase through tickets at any lower fare than has been arranged for the Chicago party, they are, of course, at liberty to do so; otherwise tickets should be purchased to Chicago and the Chicago-New York tickets purchased in that city at the party rate. A good attendance is expected on this special train, and Mr. Freeman requests that those desiring to travel on it make their reservations with him as soon as possible.

DIMINUTIVE CENTRAL STATION AT LEWIS, IA.

Gasoline-Electric Equipment Supplying Energy to a Town of 650 Inhabitants.

By J. H. Kuhns.

THE problem of electric lighting and power service for villages and small towns seems to be finding satisfactory solution in the gasoline-electric generating sets designed originally for the United States government for the long-continued and rigorous duty in seacoast fortifications. The successful use of these sets in a number of the forts has suggested their broader commercial utility. On Jan. 6 the Lewis Electric Light & Power Company started to operate at Lewis, Ia., what is believed to be the first central-station plant exemplifying the applicability of these gasoline-electric sets for street and general commercial lighting and motor service. Already there are connected to the circuits eighty customers, twenty-five of whom are new users of electric energy. Over 800 lamps, or an average of over ten lamps per customer and nearly one and one-quarter per individual member of the town's population, are connected, with still a large reserve of undeveloped business to draw upon to build up a profitable station load.

Lewis is a small town of 650 population in a rich and fertile section of the best farming country in Iowa. Farm lands are valued here at about an average of $150 an acre. Much seed corn is raised and shipped from this center. One of the most prominent horse and cattle ranches, handling high-grade stock, is located close by. As a town it has had a varied history, dating back over sixty years.

Lewis was at one time the county seat of Cass County, but was outrivaled for that honor by the more populous thriving little city of Atlantic, which has the good fortune to be situated on the main line of the Rock Island Railroad. With the building of the Atlantic & Griswold branch of the Chicago, Rock Island & Pacific Railroad a few years ago, now a connecting link between Atlantic and Red Oak, an important town on the main line of the Burlington route, Lewis spread out to the west, doubling its area and extending to meet the railway which crosses from north to south the extreme west end of the town. The railway station is at the foot of Main Street, a block west of the electric light plant. This newer portion comprises the principal business and newer residence part of the Lewis of to-day.

Five or six years ago there was installed an electric light plant in connection with a mill operated by water-power and later by steam. It met with but indifferent success in the hands of various parties. An unsuccessful effort was made to dispose of the old plant and system to the town at a considerable loss. It was then entirely dismantled and removed, a portion of the machinery being transferred to another town.

Fig. 1—Exterior of the Central Station at Lewis, Ia.

For the erection of a new plant upon more modern and progressive lines a group of business men organized the Lewis Electric Light & Power Company with the following officers and board of directors: Prof. S. W. Rowley, president; Mr. David Hickman, vice-president; Mr. William B. Davis, secretary; Mr. Ivan H. Beardsley, manager and engineer, and Messrs. Daniel Stevens, Bert Hardenberg, W. W. Albright, V. M. Elstin and M. H. Elliot, directors. The company is capitalized for $5,000, all stock being common and issued at a par value of $10 per share. No bonds have been issued. The primary purpose has been to install a thoroughly good plant and equipment, and to this end the actual cost has exceeded the capitalization, which is permissible by Iowa State law, the whole costing in round numbers $6,000. In addition, $500 to $1,000 worth of supplies is carried for the convenience of consumers. The company is operating by agreement under a franchise granted other parties some years ago, as did its predecessors, no transfer of franchise rights ever having been made. After three years the town may acquire the plant, if desired, upon payment of a valuation determined by a committee of three appraisers, one appointed by the town, one by the company and these two to select the third.

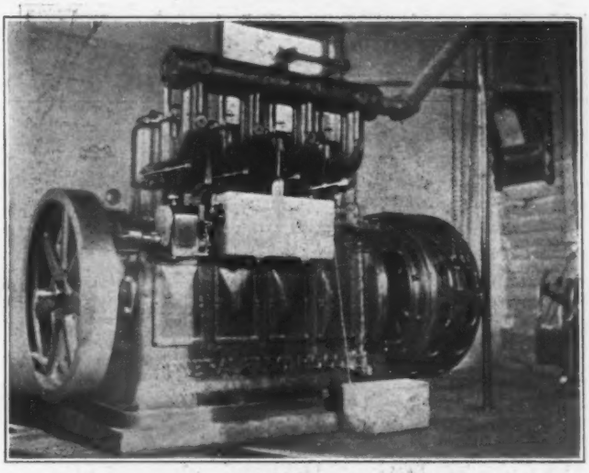


Fig. 2—Gasoline-Electric Generating Set.

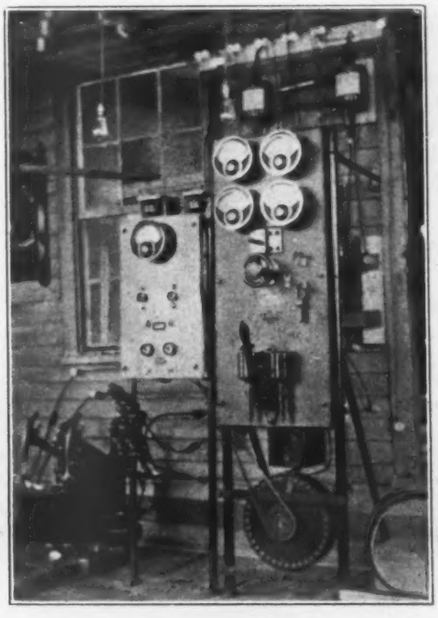


Fig. 3—Switchboard Panels.

The central station is located on Main Street, which is the principal thoroughfare, and is installed in a low one-story building for which a mere nominal rental charge is paid, the company having the option to buy the property later at the value of the land plus the cost of the improvements and simple interest on the same. To the front of an old frame building

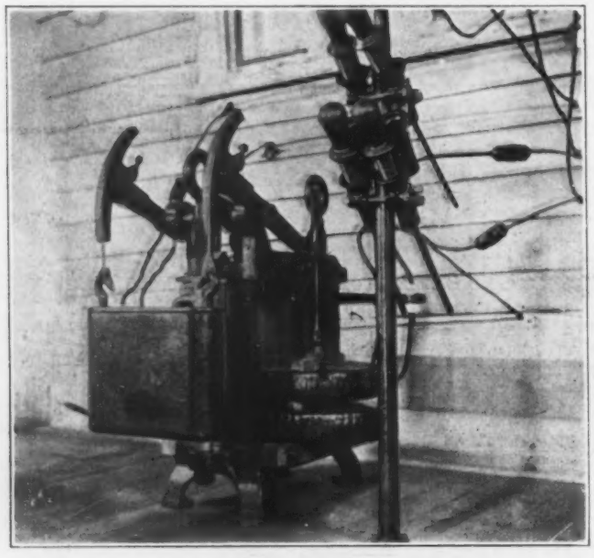


Fig. 4—Constant-Current Transformer.

about 16 ft. x 28 ft. has been built a neat, well-lighted concrete blockroom, about 16 ft. x 16 ft., carrying the building to the lot line and affording ample space for the generating set and switchboards, and such desk room as is needed for the ordinary office business of the company. In this room, which is finished in natural pine with plastered walls, has been installed a standard General Electric 25-kw gasoline-electric generating set composed of a four-cylinder, four-stroke cycle, vertical water-cooled, 43/54 hp gasoline engine direct-connected to a three-phase, 2300-volt, 600-r.p.m. alternator with a 125-volt exciter mounted on the same shaft and in the same frame. The whole is so constructed as to insure permanent alignment and prevent objectionable vibration.

The carburetor is of the constant-level type, and the gasoline is delivered by a pump connected to the engine through pipes direct from a 120-gal. tank set in the ground back of the station at a safe distance from surrounding buildings. Ignition is furnished by high-tension magneto with starting battery. Lubrication is effected by means of forced circulation through a pump connected with the engine.

Fig. 5—Modern Cottage at Lewis, Ia.

With the generating set is a slate switchboard panel mounted on iron frames and with three ammeters, one voltmeter, an instrument plug switch for voltage indication, one single-pole carbon-break switch, one automatic oil circuit-breaker line switch and rheostats. Instrument transformers are mounted above and back of the board.

For street-lighting service a 4-kw constant-current transformer has been installed, and with it a gray marble switchboard panel mounted on iron frames and carrying an ammeter and a four-point plug switch. On a board near the generator set are mounted in convenient reach suitable wrenches, spanners and repair parts and tools.

To cool the engine cylinders a battery of five galvanized cylindrical steel tanks 6 ft. in diameter and 8 ft. high have been installed in the old part of the building adjoining the generating room and slightly above the level of the latter. By means of a pump connected with the engine the water with which these tanks are filled is kept in constant circulation during operation, thus dissipating the heat from the engine jackets. It was at first attempted to effect this water cooling by using a single small tank and pumping cold water direct from a well at the rear of the building. This proved inadequate because of difficulty with the pump and frequent need of pump repairs. Hence the well and pump method was abandoned and the tank system substituted. The rest of the space in the old part of the building is utilized as a stockroom for wire and supplies.

Insufficient data have as yet been taken to ascertain the amount and cost of fuel per unit of energy. However, for a period of fifty-three days, from Jan. 21 to March 15, there has been an average daily consumption of 21 gal. of gasoline at 11.7 cents per gallon.

Evening lighting service is furnished from dark until 11 o'clock daily except Saturday, when service is extended until 12 midnight; and morning service from 5:45 until daylight. Thirty-two 6.6-amp, 32-cp series-tungsten lamps at street crossings are lighted during the regular operating hours, modified by a moonlight schedule. For this service the town pays $1 per light per month. A few additional street lamps in the residence portion will be added soon. For commercial lighting a combination schedule of flat rate and meter rate has been arranged. For a small number of lamps the charge for energy per month is 75 cents for a 16-cp lamp, $1 for two, $1.50 for three. When there are more than three lamps the circuit is metered. Consumers may own their meters or the company will furnish them on a rental charge of 25 cents per month. The company now has $260 in rented meters in service and about as many more are owned by consumers. The meter rate is 15 cents per kw-hour up to 20 kw-hours and 10 cents per kw-hour for all energy in excess of that amount.

Fig. 6—Business Section of Main Street, Lewis, Ia.

Consumers furnish their own wiring, fixtures and lamps, the company furnishing service connection to the house entrance. The company has adopted the policy of wiring houses at an advance of 10 per cent on the cost of materials, with a charge of 30 cents an hour for labor. Lamps are sold at 25 cents for a 16-cp carbon, 80 cents for a 40-watt and $1.10 for a 60-watt tungsten lamp.

Probably the best lighted house is a very pretty modern

cottage at the corner of Main and Washington Streets where twenty-three 40-watt tungsten lamps are used. The attractiveness of this well-lighted house sets a commendable example for others there and elsewhere. Liberal use of light goes a long way toward solving the problem of lighting villages and small towns, and promotes a spirit of progress that soon puts the town out of the rural village class, increases business and enhances property values.

Fig. 7—Pole and Transformer in Pole-Line Distribution System.

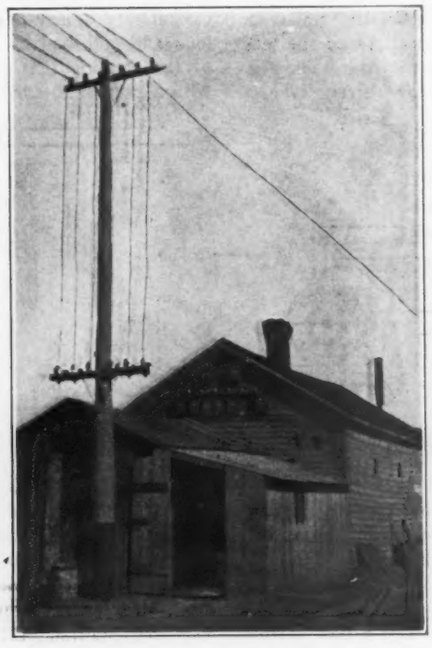


Fig. 8—Rear of the Central Station.

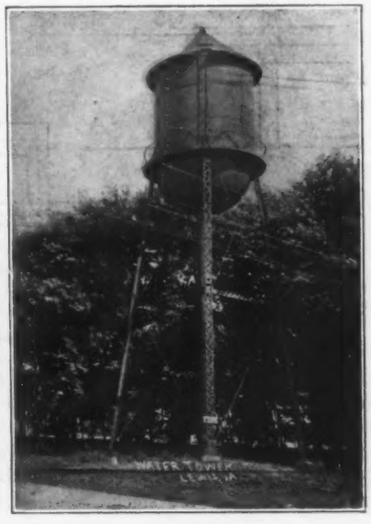


Fig. 9—Water Tower.

Negotiations are under way for operating the town pumping plant by means of a three-phase motor. The town has already bought and installed a 5-hp Fairbanks three-phase, 60-cycle, 220-volt motor belted to a countershaft and the company has run a special set of primary feed wires from the station to the pumping plant on Market Square to provide for this service. The water is lifted by a Deming pump from a 65-ft. well to a water tower on the Public Square six blocks distant on higher ground in the old part of the town. A 6-hp gasoline engine is now used for pumping, but it is estimated that not over 3 hp is required.

It is thought that by slight additional running time, or by operating a few hours in the day once or twice a week, the pumping can be done at a saving to the town and a profit to the company. The gasoline engine at the pumping station will be retained for auxiliary or emergency pumping service and probably operated by the company for the town at about actual cost of fuel and labor. A two months' trial will be given before closing negotiations.

There seems little demand in a place of this size for a day load. A possibility spoken of by the management is that in case of doing the water-works pumping it may be arranged to run the electric service on Tuesdays to care for washing machines and laundry irons, that being a convenient time for most housewives.

An electrical exhibit, perhaps with some of the practical domestic apparatus for heating and cooking, is contemplated in connection with the annual school exhibit about commencement time. It would be strange indeed if the intelligent demonstration by these bright young people of the utility, simplicity and convenience of such appliances did not influence their parents and friends to put some of these appliances into their homes.

Leaving the generating room all primary mains and feeders are carried from the back of the station to the pole line in the alley at the rear. The station equipment and circuits are protected by lightning arresters inserted where the lines leave the building. Additional lightning arresters will be placed upon the lines.

All primary and street-lighting circuits are of No. 10 weatherproof copper wire and the secondaries are of No. 6. The pole line exemplifies good regular engineering practice, though heavier poles would be an advantage. Much credit is due to the company's electrician, Mr. Ivan H. Beardsley, for his skilful construction. White cedar poles of 25-ft., 30-ft. and 35-ft. lengths, supplied by local dealers, are set from 110 ft. to 125 ft. apart.

The entire equipment was supplied by the General Electric Company and installed under the supervision of an engineer from its Chicago offices. The service is said to be unsurpassed by that of any other town of similar size.

THE SCHERBIUS SYSTEM OF SPEED REGULATION FOR INDUCTION MOTORS.

By J. J. Elink Schuurman.

THE magnetic field set up by the current in the primary windings of a polyphase induction motor revolves at a speed depending directly upon the frequency of the line and inversely upon the number of poles. The revolving field tends to turn the rotor in the same direction. The speed of the latter, however, can never equal the speed of the former, commonly known as synchronous speed, because the rotor conductors must cut the lines of force of the field in order to produce current in the secondary winding and provide a propelling torque. The difference between these two speeds is known as the slip. The strength of the secondary current depends upon the torque required by the load under which the motor is running. The e.m.f. which produces the secondary current is proportional to the slip.

The simplest means of varying the speed of an induction motor is based upon this proportion between the voltage and the slip. An external resistance, known as slip resistance, is inserted in the secondary circuit. As the secondary current is determined by the required torque, the secondary e.m.f. must increase in order that the constant current may flow through the increased resistance. The secondary e.m.f. and the slip are proportional to each other and hence the increased secondary circuit resistance will cause the speed to drop.

This method for speed regulation of induction motors has often been used, especially in connection with rolling mills, but notwithstanding its great simplicity it is most uneconomi-

cal, as an amount of energy proportional to the percentage of regulation is lost in the slip resistance. When, for instance, the speed is decreased to 30 per cent below normal, 30 per cent of the energy taken from the line is lost. The efficiency is consequently very low. Another distinct disadvantage of this method of regulation is that for a certain slip resistance the speed changes to a great extent with variations of the load and rises to practically its normal value at no load. The reason for this is that at no-load the secondary current is very

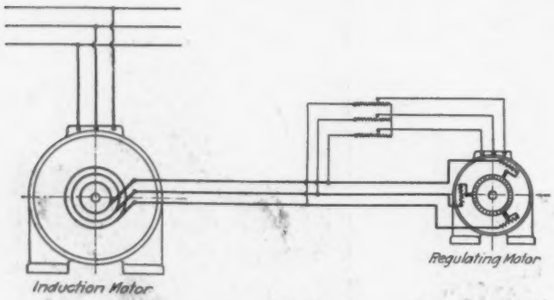


Fig. 1—Circuits of Regulating Motors.

low so that the drop of voltage in the slip-resistance, which originally caused the speed reduction, becomes negligible. This running back to the synchronous speed may be inconvenient in the operation of rolling mills when a low running-light speed is required in order that the rolls may be sure of getting a hold on the steel.

In what follows will be given a description of a new system for the speed regulation of induction motors which maintains the efficiency practically constant over the entire range of regulation, which permits of all the speed characteristics that direct-current motors are able to give, and which raises the power-factor of the installation to unity.

The principle of the system is shown in Fig. 1. Instead of a variable resistance, an auxiliary motor is connected to the slip rings of the main motor. The purpose of this so-called regulating motor is to make use of the slip energy which was formerly lost in resistance and to convert it into mechanical energy.

The regulating motor was originated by Dr. A. Scherbius. It is of the three-phase commutator type. In series with its armature winding is an absolutely identical compensating winding on the stator by which the inductive effect is entirely eliminated. It thus becomes independent of the frequency. In its operation it can be compared to a direct-current motor, its e.m.f. merely depending on the speed and the field flux.

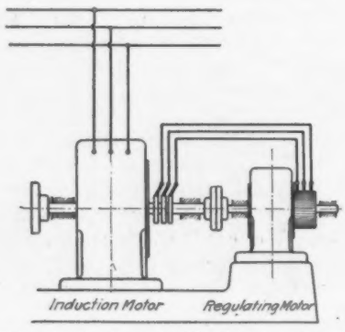


Fig. 2—Arrangement Employed with Directly Coupled Regulating Motor.

The speed regulation of the main motor is obtained in a simple manner by adjusting the excitation of the regulating motor. As the slip of the induction motor is proportional to its rotor e.m.f., its speed will decrease when the rotor e.m.f. is forced to increase, due to the counter e.m.f. of the regulating motor. The stronger the excitation of the regulating motor the lower will be the speed.

When the regulating motor is shunt-excited the speed of the main motor remains constant from no-load to full-load because the counter e.m.f. of the regulating motor, which differs from the rotor e.m.f. of the induction motor only to the extent of the ohmic drop in voltage, depends merely upon the excitation. When a drop of speed is required between no-load and full-load in order to make use of the flywheel effect of the rotating masses, the regulating motor can be provided with a compound exciting winding. As in the case of a direct-

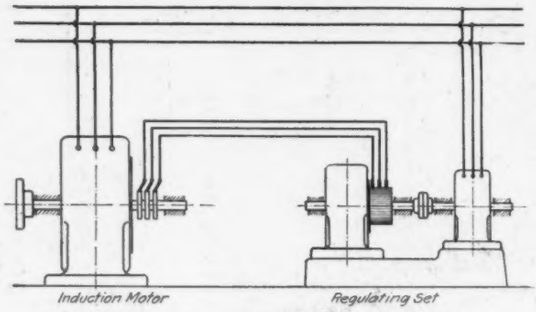


Fig. 3—Arrangement with Regulating Set.

current compound motor, the speed will drop from no-load to full-load over a certain adjustable range. Finally, a series excitation can be provided which entails a form of regulation similar to that by resistance.

The slip energy which the regulating motor converts into mechanical energy can be further employed in two different manners. First, the regulating motor can be coupled mechanically to the main motor so that the slip energy is given back to the main driving shaft (see Fig. 2).[1] Secondly, the regulating motor can be coupled with a small induction generator. This regulating set converts the slip energy into electrical energy and returns it to the line (see Fig. 3).[2] The first arrangement, in which the regulating motor is coupled directly or by means of a belt to the main motor, is in general the better one, as the available energy on the main shaft remains constant—that is, with decreasing speed the torque can be increased. In case of the arrangement with the regulating set only a constant torque is available, as in the case with regulation by resistance, so that the output must decrease with decreasing

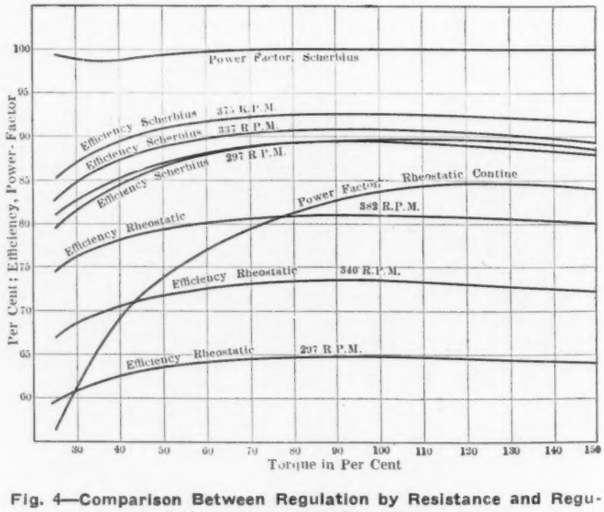


Fig. 4—Comparison Between Regulation by Resistance and Regulation with a Scherbius Motor.

speed. Further, the total efficiency is more favorable for mechanical coupling between the regulating motor and the main shaft. However, this arrangement is not always possible as the regulating motor must follow the speed fluctuations of the main motors and becomes too expensive for very wide ranges

[1] Due to Mr. Krämer, German Patent No. 169,453.
[2] Due to Dr. Scherbius, German Patent No. 179,525.

of regulation. In such cases the regulating set which runs at constant speed is preferable.

A great advantage of the regulating system described lies in the possibility of extending the regulation above synchronous speed. The result is that the regulating motor can be kept smaller than is possible with exclusive regulation below synchronism. In order to obtain over-synchronous speeds

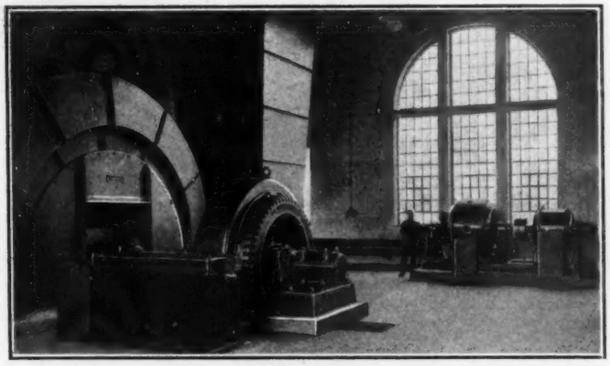


Fig. 5—Fan with Electric Drive with Regulating Set in Background at Gelsenkirchen.

the direction of the excitation of the regulating motor should be reversed. The latter then runs no longer as a motor, but as a generator. It does not take up slip energy, but, on the contrary, delivers slip energy to the main motor. The possibility of running above synchronism can also be of value for reaching very high speeds, as such are necessary for rotary blowers, rotary compressors, etc. It should be realized that in case of the normal frequency of 60 cycles per second 3600 r.p.m. was the highest speed which hitherto could be obtained. This is the synchronous speed of a two-pole motor. The next lowest speed is 1800 r.p.m. for a four-pole motor. The advantage of being able to obtain intermediate speeds, and above all, speeds over 3600 r.p.m., is obvious. Such values have until now been obtainable only with steam turbines.

The above-described system of regulation permits of compensating the phase difference between the current and the voltage of the main motor and of increasing its power-factor, independently of the load, to unity. By a small change in design the regulating motor can be made to supply the magnetizing current necessary for the excitation of the main motor. The generators at the power station and the transmission line are then relieved from delivering this wattless current. If necessary, the regulating motor can also be designed to supply the excitation for other motors on the line, and thus will contribute further to raise the power-factor of the entire system.

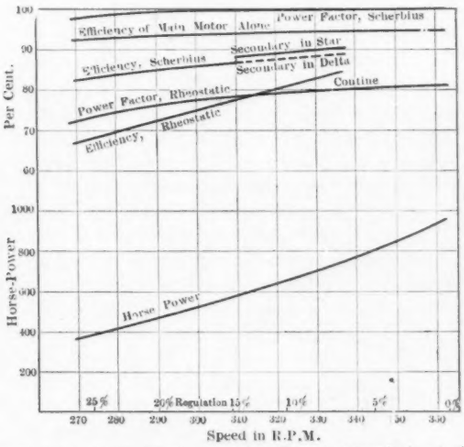


Fig. 6—Curves from Tests on the Regulating Set at Gelsenkirchen.

It has been mentioned that the regulating motor is of the three-phase commutator type. The simplest way to regulate speed by means of a three-phase motor would be to connect a three-phase commutator motor directly to the line. However, certain difficulties with respect to good commutation stand in the way of building such motors. The higher the frequency and the larger the output the greater are these difficulties. Commutator motors for several thousand horse-power, for instance, as often required in steel mills, have not yet been built, although it is to be expected that in the next few years considerable development will be made in this direction. The regulating motor described is connected to the rotor of an in-

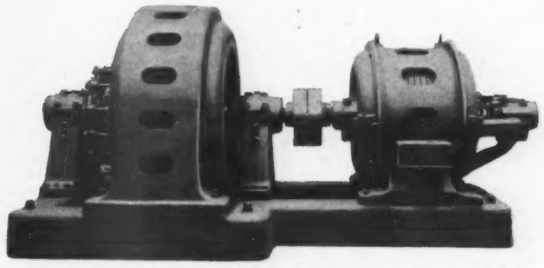


Fig. 7—Regulating Set for Varying the Speed of a 1800-hp Bar Rolling Mill.

duction motor in which the frequency is low. Moreover, its output is small when compared with the output of the main motor. Consequently the system permits of very large outputs. The rotor voltage of an induction motor can be chosen at will within wide limits, even when the motor is directly connected to the high-voltage line. Thus the voltage of the regulating motor can be kept low, which still further facilitates its design.

The Scherbius system may be used with induction motors which already exist, as well as for new installations.

On curve sheet, Fig. 4, a comparison is made between regulation by resistance and regulation with the Scherbius regulating motor. The values of efficiency and power-factor for both systems have been plotted for different torque values at different percentages of regulation.

The above-described system of regulation has already found a wide field of applications, as can be seen from Figs. 5 to 9.

Fig. 5 shows the plant for ventilating the Rheinelbe pit of

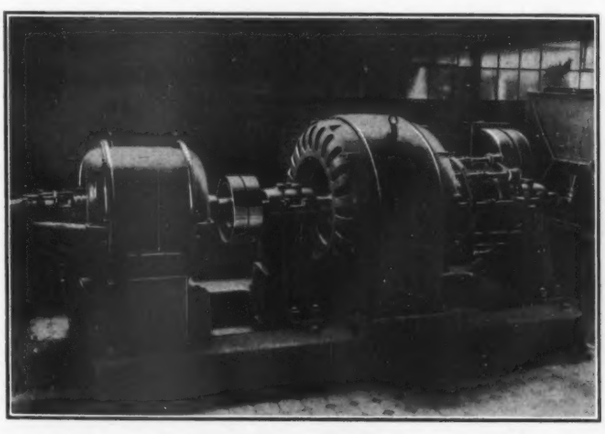


Fig. 8—Regulating Set for Varying the Speed of a 2500-hp Wire Mill at the Steel Plant, Differdingen.

the Gelsenkirchen collieries. It consists of a mining fan capable of dealing with about 290,000 cu. ft. of free air per minute at a depression of 18.5 in. water gage when running at a speed of 363 r.p.m., directly driven by an induction motor of 1000 hp maximum continuous output. As the maximum output of this plant will not be required for a number of years, it is at present operated at a speed of 268 r.p.m., corresponding

to an output of about 194,500 cu. ft. of free air at a depression equivalent to 10 in. of water. As the pit is gradually opened up a certain increase in the air quantity will be required, which will necessitate a periodical increase in the speed of the plant. The required speed regulation is obtained by means of a Scherbius regulating set designed for 200 kva and 750 r.p.m., which is shown in the background. The results of tests carried out on this plant are shown in Fig. 6. Calculations which were made from these curves have proved that the annual saving in the amount of energy consumed in the case of Scherbius control in comparison with control by resistance, namely, $4,000, for a price per kw-hour of 0.6 cents, is sufficient to pay for the entire regulating equipment in about one year's time.

Fig. 7 illustrates a 400-kva, 750-r.p.m. regulating set for varying the speed of a bar-rolling mill of the steel plant "Deutscher Kaiser," which is driven by an 1800-hp induction motor designed for 375 r.p.m. The regulating set is built for 50 per cent speed regulation of the main motor and 5 per cent drop of speed between no-load and full-load.

At the Differdingen steel plant a wire mill is in operation driven by an induction motor of 2500 hp and 150 r.p.m. which is regulated by a Scherbius set designed for 240 kva and 750 r.p.m., as shown in Fig. 8. The latter produces a 10 per cent drop of speed between no-load and full-load.

When a new rolling mill is installed it often cannot be determined beforehand what will be the most favorable speed for the process. In such cases it is advisable to design the driving motor with a sufficiently wide margin of speed. Should its speed prove to be too high the Scherbius system of regulation permits of reducing it without affecting the efficiency of the installation or its power-factor.

When the regulating motor is coupled mechanically to the main driving shaft the output of the mill can be kept constant over the entire range of regulation; that is to say, the torque can be increased at reduced speed. This may lead to an increased production at lowered speeds, as an excess load can be placed on the train.

The installations described above were built by Brown, Boveri & Company, of Baden, Switzerland.

SIMPLE METHOD OF MAKING THERMO-ELECTRIC MEASUREMENTS OF HIGH TEMPERATURE.

By J. P. Raymond.

THE following is a description of an apparatus for use in measuring high temperatures, together with a brief discussion of the theory which is involved in the use of thermo-couples.

THERMO-COUPLE.

In a circuit formed of different metals with all the points where two metals join at the same temperature the differences of potential compensate each other all around the circuit and there is no current. If, however, the joints are not at the same temperature this compensation no longer exists and the circuit is traversed by a current. There is a particular range for each couple depending upon the material from which it is made and the e.m.f. generated is proportional to the rise in temperature throughout the range of the particular couple under consideration. The usual e.m.f. of the couple mentioned in this article is from 22 millivolts to 23.5 millivolts per 1000 deg. Fahr. rise in temperature.

In practice a thermo-couple is usually composed of two metals joined together at one end and arranged so that a generation of e.m.f. will result upon the application of heat to the joined ends. Various combinations of metals may be used in such a couple, a few of which are given below. The metals named in the following list are arranged in such an order that if any two or more of them are formed into a circuit as above described there is a current across the heated junction from the metal whose name occurs first in the list to that whose name occurs later:

	Bismuth,	Manganese,	Gold,	↑
	Nickel,	Silver,	Zinc,	
Hot	Platinum,	Tin,	Iron,	Cold
	Palladium,	Lead,	Arsenic,	
↓	Cobalt,	Copper,	Antimony.	

In a thermo-couple it is immaterial whether the two metals are joined directly, are brazed or soldered together, inasmuch

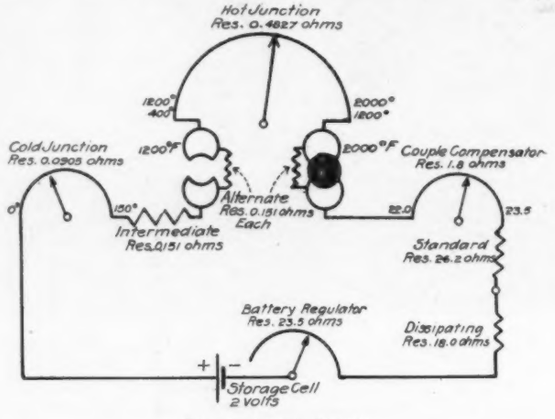


Fig. 1—Local Circuit.

as the e.m.f. is not altered if one or more metals are interposed between the metals composing the junction provided the temperatures of the two junctions are not altered.

To determine the temperature of the hot junction of the couple it is necessary to know the cold-junction temperature and by measuring the e.m.f. generated by the couple determine the difference in temperature between the two. The apparatus which will be described in this article is so designed as to provide automatically the proper correction for the cold-junction temperature as well as the various constants involved in the use of thermo-couples, eliminating the necessity for all calculations. The apparatus, therefore, provides for a direct reading of the temperature affecting the couple by a means so

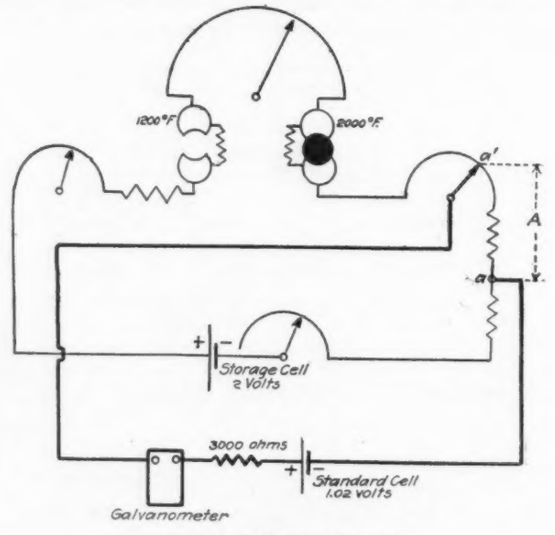


Fig. 2—Adjusting Circuit.

simple and accurate as to overcome the difficulties encountered in other types of apparatus.

CIRCUITS.

The method by which the temperature of the hot junction is determined employs the use of a local circuit and two intermediate circuits. The e.m.f. of the couple is measured by balancing it against the e.m.f. between two points separated by a

variable resistance in a local circuit through which a constant current is flowing.

The local circuit (Fig. 1) is composed of a series of resistances, a 2-volt storage cell and a battery regulator by means of which the resistance of the circuit can be varied to govern the amount of current flowing through the circuit. This current is calibrated by the use of a standard cell, as described below.

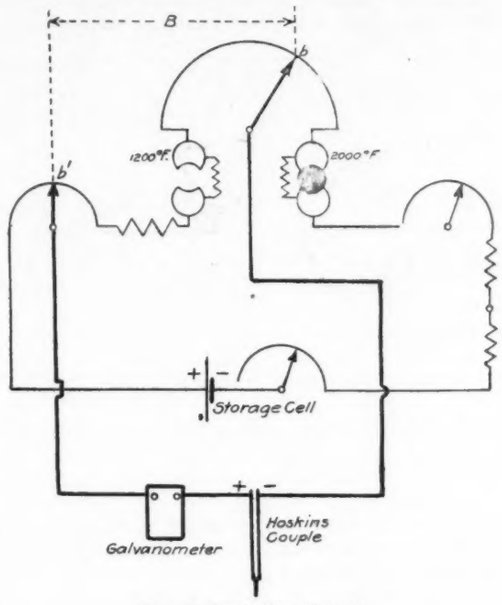


Fig. 3—Operating Circuit.

The adjusting circuit (Fig. 2) consists of a standard cell of 1.02 volts, a protective resistance and a galvanometer. The couple compensator is set to correspond with the constant of the particular couple under consideration and a voltage of 1.02 volts from the standard cell is impressed upon a certain part of the local circuit, as shown in the figure. The current in the local circuit is then adjusted by means of the battery-regulator rheostat until the e.m.f. drop between the two points (a a') exactly balances the voltage from the standard cell. This will be indicated by a zero deflection of the galvanometer. The resistances in the circuit are so proportioned that when this condition exists the proper current for the tests to be made is flowing in the local circuit. This current must be maintained constant throughout the test.

The operating circuit, as shown in Fig. 3, is composed of a thermo-couple and a galvanometer and is shunted across a certain part of the local circuit between the variable points (b b'). The point b' is obtained by setting the cold-junction dial at the proper point to compensate for the temperature of the cold junction at the couple, as described below.

A balance may be obtained in a manner similar to that described above by moving the dial of the hot-junction resistance, thus varying the resistance comprehended between the points b and b' by known steps. By this means with a known current and a known resistance the voltage generated by the thermo-couple may be determined. As the generation of the thermo-couple per 1000 deg. Fahr. is known, to facilitate operation, a scale on the face of the hot-junction resistance is calibrated to read directly the temperature of the hot end.

DESCRIPTION OF RESISTANCES.

To eliminate any possibilities of error the resistances should be made of some resistance wire whose temperature coefficient is very low, and should be calibrated very carefully.

(a) The couple compensator, Fig. 1, is a resistance that can be adjusted to compensate for variations in the constants of different thermo-couples that may be used with the apparatus and is calibrated in millivolts per 1000 deg. Fahr. The calibration covers a range of from 22 millivolts to 23.5 millivolts.

(b) The hot junction is a resistance used to vary the resistance comprehended between the points (b b'), as shown in Fig. 3, and hence to vary the e.m.f. drop across the operating circuit, and is calibrated to read directly the temperature of the hot end of the couple.

(c) The cold junction is a resistance that may be used to compensate for variations in room temperature and is calibrated in units of temperature from 0 deg. to 150 deg.

(d) The alternate resistance is used to give a larger range to the reading of the hot-junction resistance, thus giving a double scale to the instrument.

A galvanometer of not less than 200 ohms resistance and 500,000 ohms sensibility should be used and if the temperature difference must be read closer than 5 deg. to 10 deg. a more sensitive galvanometer should be used. A double-throw key is used in this circuit. Fig. 4 shows the completed circuit, different sections of which were shown in the previous figures.

OPERATION.

From the above the five steps necessary to operate the pyrometer are as follows:

1. Connect the storage cell (2 volts), standard cell (1.02 volts) and thermo-couple, making certain of their respective polarities and then connect the galvanometer.

2. Set the couple compensator to the values designated on the calibration tag accompanying the thermo-couple.

3. Operating both keys, adjust the battery regulator until the galvanometer shows no deflection.

4. Set the cold-junction dial to the temperature of the free end of the thermo-couple as determined by a mercurial thermometer.

5. With the plug firmly seated in either socket, depress the galvanometer key and adjust the hot-junction dial until a balance results, changing the plug to the other socket if necessary. The actual temperature of the furnace is then read from the scale of the hot-junction dial.

EXAMPLE.

Taking an example to illustrate the operation, suppose a temperature of 1500 deg. Fahr. is to be measured. The temperature of the air near the furnace is 75 deg. and the constant of

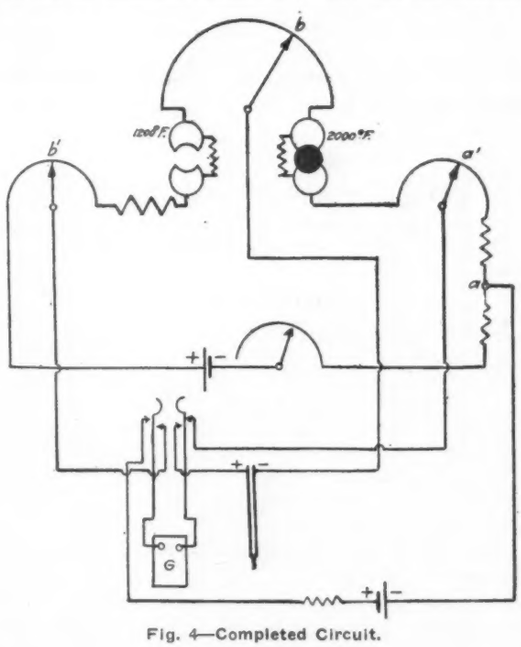


Fig. 4—Completed Circuit.

the thermo-couple is 22.5 millivolts per 1000 deg. Fahr. Set the couple-compensator dial to 22.5. In determining the current flowing in the local circuit use is made of a standard cell, its emf of 1.02 volts being impressed across the terminal of the 26.2-ohm resistance and the compensating point of the couple-compensator resistance. The total resistance is, then, assuming the variable portion of the resistance by proportion, 26.2 +

1.2 = 27.4 ohms. Therefore, the current flowing when a balance is established will according to Ohm's law be 1.02 ÷ 27.4 = 0.372 amp. This current also traverses the entire local circuit.

The cold-junction dial is set at 75 deg. to conpensate for the cold-junction temperature—that is, room temperature—and the potential of the thermo-couple is impressed between this point and a variable point on the hot-junction resistance. As the temperature to be measured is 1500 deg. Fahr. when the movable arm of the hot junction is placed at this reading the resistance between this point and the 75-deg. point on the cold-junction resistance is 0.04525 + 0.151 + 0.4827 + 0.181 = 0.8599 ohm, again assuming the variable resistances by proportion. Thus, the current and the resistance being known, the e.m.f. which will cause a flow of 0.0372 amp through a resistance of 0.8599 ohm equals 0.03199 volt. This value is also the value due to the difference of temperature of 1425 deg. Fahr. between the junctions, assuming that the thermo-couple develops 22.5 millivolts per 1000 deg. Fahr.

Therefore, should the temperature of the hot end of the couple be 1500 deg. and of the cold end 5 deg. the thermo-e.m.f. will just balance the drop across the included resistances *B* (Fig. 3) and there will be no deflection of the galvanometer in the couple circuit. Should there be a deflection of the galvanometer the hot-junction dial can be readjusted until the deflection is eliminated and the actual temperature can then be read from the scale.

In this particular apparatus a Hoskins thermo-couple was used and very satisfactory results were obtained. Where it is essential that high temperatures must be measured under conditions of high pressure the results obtained by the above method are accurate and may be obtained in a practical way. The results may be considered as accurate as those obtained by any other known method, the benefit being that all corrections are made before the reading is taken and the temperature then read directly from the scale.

This apparatus may be made up in portable form, or in cases where it is desired to read the temperature of a number of furnaces at frequent intervals a complete system may be installed by bringing the leads from the various couples to a central point. Suitable switching arrangements may be installed at this point and the apparatus and galvanometer set up in such a way that the temperature of any one of the furnaces may be obtained at once by making the proper switching connections.

LOSSES IN SINGLE-PHASE ROTORS.—I.

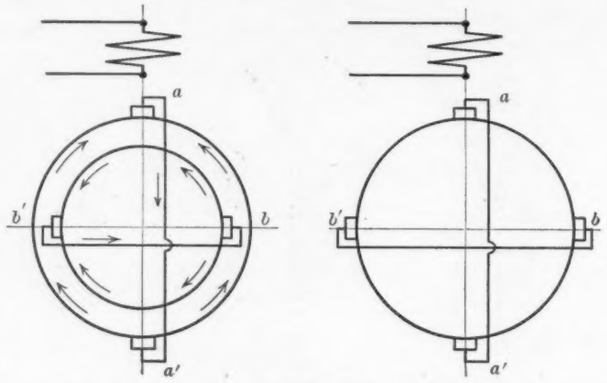
Rotors of the Squirrel-Cage Type.

By H. Weichsel.

THE theory of single-phase motor phenomena has for a long time been considered so complicated that exact solutions of some of the problems involved are not attempted. The main reason for this is that most investigators make use of the rotating-field theory, considering that the single-phase field may be considered decomposed into two fields rotating in opposite directions. This theory is correct and should lead to the solution of all problems involving the single-phase motor, but frequently it will be found that it is rather difficult by this method to gain a clear physical conception of the phenomena involved.

Another theory reduces all phenomena occurring in single-phase motors to conditions similar to those in direct-current motors. It is this theory which will be used in this paper in determining the losses in single-phase rotors. According to this theory the rotor secondary of a single-phase motor carries two different currents. One of these is the working current and travels through the secondary in such a direction as to produce a field in the axis of the stator pole. The other may be called the rotor magnetizing current and produces a field at right angles to the axis of the stator pole. The conditions as stated may be illustrated in Fig. 1, where two separate windings are shown for the different currents. Conditions will be unchanged, however, if the two currents exist in the same winding, as shown in Fig. 2. The problem before us is now to determine the rotor secondary copper losses in this kind of a motor.

As before stated, each conductor of the rotor winding carries



Figs. 1 and 2—Equivalent Circuits of Single-Phase Rotor.

two currents, the working current I and the magnetizing current i. For an ideal motor these two currents are in time-phase with each other, but in the practical motor there will be a certain time-phase displacement between them which may be designated as α. Referring to Fig. 5, let I be the effective value of the rotor-working current and i the effective value of the rotor-magnetizing current. It is evident that the effective value of the resultant current flowing in any conductor located in the quadrant a-b (Fig. 2) will be

$$I_{r_1} = \sqrt{I^2 + i^2 + 2Ii\cos\alpha}$$

Also the current in any conductor in the quadrant b-a' will be

$$I_{r_2} = \sqrt{I^2 + i^2 - 2Ii\cos\alpha}.$$

If r is the resistance of one conductor, then the power dissipated in the copper of any conductor in quadrant a-b is equal to

$$P_{c_1} = (I^2 + i^2 + 2Ii\cos\alpha)\, r$$

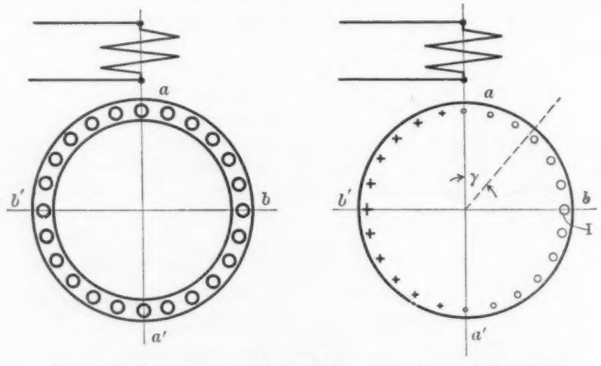
and in the same way the losses in any conductor in quadrant b-a' are equal to

$$P_{c_2} = (I^2 + i^2 - 2Ii\cos\alpha)\, r$$

If there are z conductors per pole the total secondary copper losses per pole are

$$P_c = (P_{c_1} + P_{c^2}) = (I_2 + i^2)\, rz$$

This equation reveals the very important fact that the rotor copper losses in a motor, as shown diagrammatically in Fig. 2,

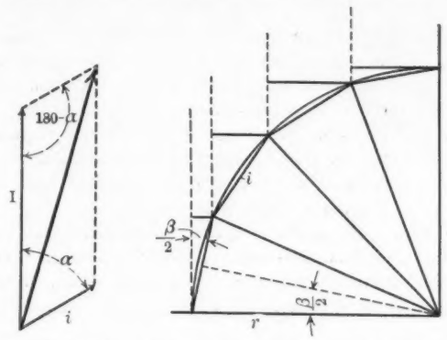


Figs. 3 and 4—Squirrel-Cage Rotor Circuits and Currents.

are independent of the time-phase relation between the working current in the axis a-a' and the magnetizing current in the axis b-b'. The total rotor copper losses are, according to the above equation, equal to the sum of the copper losses that would be produced if each current were considered by itself.

The single-phase induction motor as ordinarily built is, however, not like the one shown in Fig. 2, but is of the squirrel-

cage type, as shown in Fig. 3. Here the secondary rotor currents may also be considered as composed of two currents, one of which flows through the armature in such a direction as to produce a field in the axis *a-a'*, and the other current at the same time produces a field in the axis *b-b'*. The only difference between the motor of Fig. 2 and that of Fig. 3 lies in the



Figs. 5 and 6—Secondary Currents and Magnetomotive Forces.

fact that all of the conductors of the first are connected in series, and so the currents are the same in all conductors. In the latter, however, the conductors may be considered as connected in parallel, and the currents in the different conductors have different maximum values at any one instant, depending upon their position with respect to the stator pole. If it be assumed that the stator field has sine-shaped space distribution it will be evident that the currents in the axis *a-a'*, as well as the currents in axis *b-b'*, will also have sine-shaped distribution in space. The fact that the current in any rotor conductor varies with the position of that conductor makes it a little more difficult to calculate the total rotor copper losses. The current distribution in space may be graphically represented, as shown in Fig. 4, where the sizes of the crosses and points indicate the relative values of the working currents producing a field in axis *a-a'*. Here it is seen that the maximum current exists in that conductor which is in the axis *b-b'*. The maximum value of this current may be designated as I_b.

In the same way it follows that the conductor in axis *a-a'* carries the maximum magnetizing current. Both currents have sine-shaped distribution in space, so that in a conductor located γ degrees from the center line of the stator pole, the maximum value of the working current will be

$$I_\gamma = I_b \sin \gamma$$

and the maximum value of the magnetizing current in the same conductor is

$$i_\gamma = i_a \cos \gamma$$

If it be assumed that the current also varies in time according to the sine law, then the instantaneous value of the working

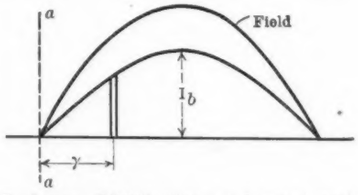


Fig. 7—Space, Distribution of Current and Field.

current in a conductor located γ degrees from the center line of the stator pole will be given by the expression

$$I_\gamma t = I_b \sin \gamma \sin (\omega t)$$

where $$\omega = 2\pi f = \frac{2\pi}{T}$$

T = the time of one period.

The instantaneous value of the magnetizing current can also be expressed by a similar equation. That is,

$$i_\gamma t = i_a \cos \gamma \sin (\omega t + \alpha)$$

where α is the time-phase displacement between the working current and the magnetizing current. The total current in the conductor is the sum of $I_\gamma t$ and $i_\gamma t$ and has, therefore, the value

$$I_\gamma t + i_\gamma t = I_b \sin \gamma \sin (\omega t) + i_a \cos \gamma \sin (\omega t + \alpha)$$

The copper losses in this one conductor during one period T will be

$$P_{c\gamma} = \frac{r}{T} \int_0^T [I_b \sin \gamma \sin (\omega t) + i_a \cos \gamma \sin (\omega t + \alpha)]^2 dt$$

$$= \frac{r}{T} \left\{ \int_0^T I_b^2 \sin^2 \gamma \sin^2 (\omega t) dt + \int_0^T i_a^2 \cos^2 \gamma \sin^2 (\omega t + \alpha)\, dt + 2 \int_0^T I_b i_a \frac{\sin 2\gamma}{2} \sin (\omega t) \sin (\omega t + \alpha)\, dt \right\}$$

This is the resistance of one conductor multiplied by the square of the average value of the current in that conductor. These three integrals can well be evaluated separately.

$$\int_0^T I_b^2 \sin^2 \gamma \sin^2 (\omega t)\, dt = I_b^2 \sin^2 \gamma \left[\frac{\omega t - \sin (\omega t) \cos (\omega t)}{2\omega} \right]_0^{t=T}$$

when $t = T$, $\omega = \frac{2\pi}{T}$. Substituting the limiting values, there is obtained as the value of this first integral

$$\frac{T}{2} I_b^2 \sin^2 \gamma \qquad (1)$$

The second integral is

$$\int_0^T i_a^2 \cos^2 \gamma \sin^2 (\omega t + \alpha)\, dt = i_a^2 \cos^2 \gamma \left[\frac{(\omega t + \alpha) - \sin (\omega t + \alpha) \cos (\omega t + \alpha)}{2\omega} \right]_0^{t=T}$$

Substituting the limiting values as above, we get

$$\frac{T}{2} i_a^2 \cos^2 \gamma \qquad (2)$$

The last integral is

$$2 \int_0^T I_b i_a \frac{\sin 2\gamma}{2} \sin (\omega t) \sin (\omega t + \alpha)\, dt = I_b i_a \sin 2\gamma \int_0^T \sin (\omega t) \sin (\omega t + \alpha)\, dt$$

$$= I_b i_a \sin 2\gamma \left\{ \int_0^T \sin^2 (\omega t) \cos \alpha\, dt + \int_0^T \sin (\omega t) \cos (\omega t) \sin \alpha\, dt \right\}$$

$$= I_b i_a \sin 2\gamma \left\{ \frac{\cos \alpha}{2\omega} \left[\omega t - \sin (\omega t) \cos (\omega t) \right]_0^T - \frac{\sin \alpha}{4\omega} \left[\cos (2\omega) \right]_0^T \right\}$$

Substituting the limits as in the previous cases, there is obtained as the value of the third integral the expression

$$\frac{T}{2} I_b i_a \sin 2\gamma \cos\alpha \qquad (3)$$

Collecting these terms, it is found that the copper losses in one conductor during one period T will be

$$P_{cT} = \frac{r}{T}\left\{\frac{T}{2} I_b^2 \sin^2\gamma + \frac{T}{2} i_a^2 \cos^2\gamma + \frac{T}{2} I_b i_a \sin 2\gamma \cos\alpha\right\}$$

$$= \frac{r}{2}\left\{I_b^2 \sin^2\gamma + i_a^2 \cos^2\gamma + I_b i_a \sin 2\gamma \cos\alpha\right\}$$

There are z conductors per pole, and the above equation gives the losses in only one conductor. In order to determine

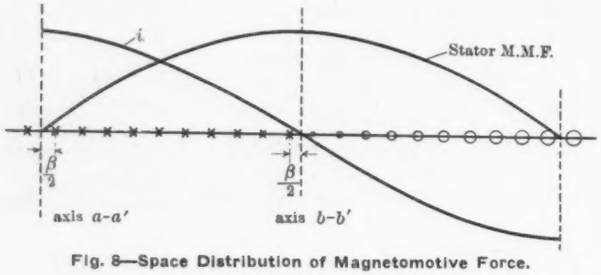


Fig. 8—Space Distribution of Magnetomotive Force.

the total losses assume that the conductors are entirely distributed over the surface of the armature; then the part of the polar arc covered by one conductor will be $\frac{\pi}{z}$. In any one element $d\gamma$ of the armature surface the losses will be

$$dP_c = \frac{rz}{2\pi}\left[I_b^2 \sin^2\gamma + i_a^2 \cos^2\gamma + I_b i_a \sin 2\gamma \cos\alpha\right] d\gamma$$

and the total losses per pole are

$$P_c = \frac{rz}{2\pi}\left\{\int_0^{\pi} I_b^2 \sin^2\gamma\, d\gamma + \int_0^{\pi} i_a^2 \cos^2\gamma\, d\gamma + \int_0^{\pi} I_b i_a \sin 2\gamma \cos\alpha\, d\gamma\right\}$$

$$\int_0^{\pi} I_b^2 \sin^2\gamma\, d\gamma = \frac{\pi}{2} I_b^2$$

$$\int_0^{\pi} i_a^2 \cos^2\gamma\, d\gamma = \frac{\pi}{2} i_a^2$$

$$\int_0^{\pi} I_b i_a \sin 2\gamma \cos\alpha = 0$$

Substituting these values, there is obtained

$$P_c = \frac{rz}{2\pi}\left\{\frac{\pi}{2} I_b^2 + \frac{\pi}{2} i_a^2\right\}$$

$$= \frac{rz}{4}\left\{I_b^2 + i_a^2\right\}$$

This represents the total armature copper losses per one pole where

r = ohmic resistance of one armature conductor.

z = armature conductors per pole.

I_b = the time maximum of the working current through the conductor located in axis b-b'

i_a = the time maximum of the magnetizing current through the conductor located in axis a-a'.

The equation shows that the losses are independent of the time-phase relation between the working current and the magnetizing current.

The equations just derived give a means of calculating the armature copper losses when the currents are known. The rotor currents, however, are a function of the load. In order to simplify their calculation assume an ideal motor without leakage and with rotor resistance negligible as compared with the rotor inductance. Under the above assumptions it follows that at synchronism the rotor field in axis b-b' will be equal in strength to the main stator field in axis a-a'. If this latter has sine-shape distribution in space it is evident that the rotor field in axis b-b' has sine-shaped distribution also. The rotor magnetizing current, producing the rotor field, must have cosine distribution in space. This is shown in Figs. 6 and 8.

Referring to Fig. 8, let $\beta = \frac{\pi}{z}$ be the angle between the centers of two adjacent conductors. The mmf in the center of the pole is the sum of all the mmfs produced by conductors located symmetrically with respect to the axis b-b'. The m.m.f. in the center of the pole is, therefore,

$$M = i_a \sin\left(\frac{\beta}{2}\right) + i_a \sin\left(\frac{3\beta}{2}\right) + i_a \sin\left(\frac{5\beta}{2}\right) + \text{etc.}$$

This equation can easily be expressed graphically, as shown in Fig. 8. The quadrant represents the angular displacement between axis a-a' and axis b-b'. This is divided into sections representing the angular displacement between two adjacent conductors. If the chord be considered as proportional to the maximum value of the magnetizing current, then the summation of the terms in the equation given above will be equal to the radius of the circle. From this it follows that

$$r = M = \frac{i_a}{2\sin\frac{\beta}{2}}$$

$$\sin\left(\frac{\beta}{2}\right) = \sin\frac{\pi}{2z}$$

Since $\frac{\beta}{2}$ is a very small angle, it may be said that

$$\text{sine}\,\frac{\beta}{2} = \frac{\beta}{2} = \frac{\pi}{2z} \text{ and } M = \frac{i_a z}{\pi}$$

The magnetic induction in the center of the pole is, therefore,

$$B_c = \frac{4\pi}{10} \cdot \frac{i_a z}{\pi \delta} = 0.4\,\frac{i_a z}{\delta}$$

and the total number of lines in the direction of the axis b-b' is, therefore,

$$N_b = B_c \tau l \frac{2}{\pi} = 0.4\,\frac{I_a z}{\delta} \cdot \frac{\tau l}{\pi} \times 2,$$

where τ is the pole-pitch and l is the axial length of the rotor core.

The above treatment has been based on an ideal motor without leakage; in which case at synchronism the field "N_b" equals the stator main field "N_o." At any other speed

$$N_b = \frac{V_o}{V_1} N_o = N_o\,(1 - s) \quad \text{where } s = \text{slip.}$$

Substituting and solving for i_a, there is obtained

$$i_a = \frac{(1-s)\,N_o\,\delta\,\pi}{0.4\,z\,\tau\,l \times 2} = 3.927\,(1-s)\,N_o\,\frac{\delta}{z\,\tau\,l}$$

i_a = time maximum of magnetizing current through a conductor located in axis a-a'

N_o = time maximum of total lines in main field (sine-shaped space distribution assumed).

δ = length of single air-gap, centimeters.

z = number of conductors per pole.

τ = effective pole-pitch in centimeters.

l = length of armature in centimeters.

s = slip of rotor as a fraction of the synchronous speed.

The value of the working current in the rotor axis b-b' may be determined from the torque required. Under the previous assumption of an ideal motor without leakage we find that the working current I_b is in time phase with the magnetizing current i_a. The space distribution of the current I_b is the same as the space distribution of the rotor field N_b in axis b-b'. Fig. 7 represents this relation.

The torque acting on a conductor γ degrees from axis a-a' is given by the expression

$$T_q = k\,l \sin\gamma \sin(\omega t)\, B_c \sin\gamma \sin(\omega t)$$
$$= k\,l\,I_b\,B_c \sin^2\gamma \sin^2(\omega t)$$

The average torque on this conductor during one period is, therefore,

$$T_q = k\,l\,I_b B_c \sin^2\gamma \frac{1}{\pi} \int_c^{\pi} \sin^2(\omega t)\, dt = \tfrac{1}{2} k\,l\,I_b B_c \sin^2\gamma$$

This is the average torque acting on one conductor located γ degrees from the axis a-a'. One conductor covers $\pi \div z$ degrees of the pole face. The torque acting on one pole of the rotor winding is, therefore,

$$T_q = \tfrac{1}{2} k\,l\,I_b\,B_c \int_0^{\gamma=\pi} \frac{\sin 2\gamma}{\pi \div z}\, d\gamma$$

$$T_q = \tfrac{1}{2} k\,I_b\,B_c\,l \frac{z}{\pi} \cdot \frac{\pi}{2} = \tfrac{1}{4} k\,z\,I_b\,B_c\,l$$

It has been seen that

$$N_b = B_c\,\tau\,l \frac{2}{\pi}$$

and

$$B_c = \frac{N_b \pi}{2\tau l}$$

Substituting this in the equation for torque, we get

$$T_q = \tfrac{1}{4} k\,z\,I_b \frac{N_b \pi}{2\tau}$$

and

$$I_b = \frac{2.55\,T_q\,\tau}{k\,z\,N_b}$$

The coefficient k depends on the units of measurement used for T_q, τ and N_b.

The losses in the squirrel-cage rotor can, therefore, be expressed as:

Copper losses due to the rotor magnetizing current

$$P_{cm} = \frac{i_a^2\,r\,z}{4} = \frac{(3.927)^2}{4} \cdot \frac{N_o^2\,\delta^2\,(1-s)^2\,r}{z\,\tau^2\,l^2}$$
$$= 3.855 \frac{N_o^2\,\delta^2\,(1-s)^2\,r}{z\,\tau^2\,l^2}$$

Copper losses due to the working current

$$P_{cw} = \frac{I_b^2\,r\,z}{4} = \frac{(2.55)^2}{4} \cdot \frac{T_q^2\,\tau^2\,r}{k^2\,z\,N_b^2} = 1.625 \frac{T_q^2\,\tau^2\,r}{k^2\,z\,N_b^2}$$

$N_b = N_o$ at synchronism.

In a later article the losses in rotors of the coil-wound type will be treated in detail.

UNDERGROUND TELEPHONE AND TELEGRAPH CABLE BETWEEN PHILADELPHIA AND WASHINGTON.

THE American Telephone & Telegraph Company is at present engaged in installing about 135 miles of conduit and cable between Philadelphia and Washington in order to preclude a recurrence of the conditions that existed at the inauguration of President Taft in 1909, when Washington was completely isolated from the rest of the world.

Fig. 1—Plowing Trench.

The stretch of cable from Philadelphia to Washington will pass through Wilmington and Baltimore, and is the first of a series of similar stretches that will ultimately form a continuous underground telephone and telegraph route from Boston to Washington. At the present time the longest commercial telephone circuits wholly in underground cable are those between New York and Philadelphia, a distance of less than 100 miles. While the outward dimensions and appearance of the cable between Philadelphia and Washington will be the same as that of the present cable between New York and Philadelphia, the wires are larger and are so arranged that from each two pairs of the larger wires in the cable it is possible to obtain simultaneously three complete telephone and eight complete telegraph circuits. There are also within the sheath a number of pairs of smaller wires for use between

Fig. 2—Trench Excavator.

intermediate cities along the route, which may also be used for telegraphic purposes. All told, 148 wires arranged in seventy-four pairs and capable of giving ninety-nine telephone and 296 telegraph communications simultaneously are contained within the 29/16-in. lead pipe which forms the protective coating of the cable. The section between Philadelphia and Washington which is now being laid requires somewhat less than two-thirds of the cable needed to connect New York with

Washington, but yet involves the making and handling of nearly 1500 reels of lead-sheath cable, having a total weight of nearly 3000 tons. Each of the cables averages about 500 ft., and 1500 splices, involving more than 250,000 wiped joints, must be made. Of the 3000 tons weight of cable, approximately 900 tons are copper conductors, being in the form of more than 20,000 miles of wire. Seventeen hundred tons are accredited to the weight of the pipe sheath, of which about 50 tons are in the form of pure tin, the remainder being lead. The paper used for insulating individual wires contributes about 140 tons and is in the form of ribbon, more than 24,000 miles long. At intervals along the cable the wires are connected to Pupin loading coils. Altogether, nearly 10,000 of these loading coils in nearly 400 cast-iron cases are to be used between Philadelphia and Washington. To form the iron cores for the loading coils more than 17 tons of the best Norwegian iron has been drawn into 155,000 miles of wire about the size of a horsehair. The data on the line are given in the tabulation that is printed herewith.

NEW YORK-WASHINGTON DUPLEX CABLE AND LOADING COIL EQUIPMENT.

Item.	Philadelphia-Washington Section.	New York-Philadelphia Section.	Total.
Cable:			
Length	135.3 miles	86.7 miles	222.0 miles
Number reels (500 ft.)	1,429	916	2,345
Carloads	119	77	196
Total weight	2,720 tons	1,735 tons	4,455 tons
Number separate copper wires	148	148	148
Weight of copper wire	893 tons	572 tons	1,465 tons
Length of copper wire	20,000 miles	13,000 miles	33,000 miles
Weight of sheath:			
Lead	1,637 tons	1,046 tons	2,683 tons
Tin	50 tons	32 tons	82 tons
Total	1,687 tons	1,078 tons	2,765 tons
Weight of paper	137 tons	88 tons	225 tons
Length of paper ribbon	24,100 miles	15,400 miles	39,500 miles
Number of wire joints	226,000	145,000	371,000
Number of loading points	97	62	159
Loading coils:			
Number of	9,603	6,138	15,741
Number of pots	388	248	636
Weight of pots (equipped)	204 tons	130 tons	334 tons
Length of cable stubs	3,104 ft.	1,984 ft.	5,088 ft.
Length of wire in stubs	174 miles	111 miles	285 miles
Weight of copper in windings	52,820 lbs.	37,200 lbs.	95,400 lbs.
	29.1 tons	18.6 tons	47.7 tons
Length of copper winding	1,370 miles	870 miles	2,240 miles
Length of copper conductor	6,720 miles	4,290 miles	11,010 miles
Loading coils:			
Weight of iron core wire	34,200 lbs.	21,900 lbs.	56,100 lbs.
	17.1 tons	10.95 tons	28.05 tons
Length of iron wire	155,000 miles	99,000 miles	254,000 miles
Time required to draw iron—for whole job, 11 weeks; entire fine-wire output of Roeblings'.			
Area film insulation on iron and copper wires	24.7 acres	15.8 acres	40.5 acres
Operation:			
Number telephone conversations at any point in cables.	99	99	99
Number telegraph messages at any point in cables (assuming each circuit composited, with duplex telegraphic operation)	296	296	296

WILMINGTON-WASHINGTON CONDUIT.

The Wilmington-Washington conduit follows the route over which Professor Morse planned to lay an underground telegraph conduit in the early days of the telegraph business. This stretch involved the digging of a trench approximately 100 miles long along the highways, over hill and dale, the laying of ducts and placing of cables. Seventy-five bridges had to be crossed, each involving its own peculiar problem in telephone engineering, and in the construction of this underground conduit line some new and interesting features of telephone engineering were used.

The work of trenching was divided into three sections and let to contractors as follows: Section 1. From the southwesterly line of the city of Wilmington, Del., to the west bank of the Susquehanna River at Havre de Grace, Md. Section 2. From the west bank of the Susquehanna River at Havre de Grace, Md., to the northeasterly line of the city of Baltimore, Md. Section 3. From the southwesterly line of Baltimore, Md., to the northeasterly line of the District of Columbia.

Fig. 3—Scraper Used for Back-Filling Trench.

The concrete manholes used on this conduit line are an innovation in telephone construction. This manhole, which is constructed entirely of concrete, has been substituted for the bricked-up manhole with iron cover in general use in underground work. The manhole is barrel shape—3 ft. wide by 4 ft. 6 in. long with 3 ft. of head room. The walls consist of four concrete slabs, 3 in. thick, reinforced by expanded metal. The roof is formed by two reinforced-concrete slabs, 4 in. thick. The flanged cover is also of reinforced concrete, 24 in. in diameter. When in place the manhole cover is 12 in. below the street grade. A concrete post, 4 in. x 6 in., is set 2 ft. out of the ground at the side of the road, so that the exact position of the manhole may be readily ascertained. Upon each post are stenciled the number of the manhole and its exact distance from the marker. The manholes were placed at an average distance apart of approximately 500 ft.

On Section 1 a trenching machine was successfully used by the contractor. The records of the engineers show that this machine excavated daily 1000 ft. of trench, 18 in. wide and 3 ft. deep, removing the dirt. The machine showed a capacity of

Fig. 4—Traction Engine Used for Rolling Trench.

3 ft. of clean trench for each minute of actual working time. To operate it an engineer and two assistants are required.

On other sections of the work the trenching plow was used. This plow was drawn by two mules, or horses, driven abreast or tandem. The first plowing was at a depth of a few inches for a distance of about 300 ft.; then the shovelers were put on to throw out the dirt while the plow was breaking up another section, and this operation was repeated until the required

depth was reached. The mules were frequently driven tandem in the trenches.

The line consists of four ducts, except where it passes through towns, where the number is increased to five and six. The ducts used are what are commonly known as pump logs. The ducts are 7 ft. in length, 3 in. inside measure, and are treated with creosote by special process. They are of Southern yellow pine, thoroughly saturated with dead oil of coal tar, which is forced into the pores of the wood under pressure, the standard of requirement being 15 lb. of oil to each cubic foot of wood.

The ends of the pump log ducts fit together, making a tight point requiring no cement. Over 300,000 pieces of duct were required for the Wilmington-Washington line.

In the preliminary surveys all bridges and crossings had been carefully studied and the best methods of crossing them determined. The usual method employed in the past has been to protect the cables by means of iron pipe, but this method possesses many disadvantages, chief among them being the fact that within a few years after being laid the iron is liable to rust and disintegrate. For this reason iron pipe in connection with bridge crossings has been avoided wherever possible. In the case of only six out of the seventy-five bridges on the present work was it found necessary to make use of it.

Running a telephone duct across a bridge involves many problems. The conduit must not interfere with traffic. In case of a bridge over a railroad the duct cannot be suspended where it would reduce the head room; if avoidable it must not be suspended where the spring freshets will force débris against it. Wherever placed, the telephone duct must be protected from damage in every possible way. In many cases this was accomplished by incasing the ducts in a wooden box made of heavy creosoted plank, supported by angle iron and suspended by iron hangers from the bridge structure. In some cases the angle iron has been laid across the bridge girders beneath the flooring, the ducts running across on wooden blocks placed at intervals, the whole being protected from mechanical injury by a wrought-iron plate or shield on the top and sides, a new thing in telephone construction. This metal shield is for the purpose of protecting the wooden ducts from the danger of being pierced by spikes when repairs are being made on the bridge.

Where the conditions made it necessary to suspend the ducts from the side of the bridge the engineers have swung the conduit on a curve, using iron ducts protected by concrete construction. On the bridge the ducts are run in a heavy plank box resting on angle iron and secured by iron hangers to the bridge structure.

After the ducts had been laid and 6 in. of dirt carefully filled in around them and tamped, a road roller was used and another layer of about 6 in. was filled in and tamped. This process was continued until the trenches were filled. A road roller weighing about 1000 lb. was used to pack the filling as solidly as possible. On Section 2 the earth was filled in loosely and crowned about 6 in. and a heavy steam road roller weighing about 10 tons was run over it many times.

Many of the roads between Baltimore and Washington are improved highways, a 14-ft. strip of macadam running down the center of the road. Some of the roads had been oiled, and it was feared that the work on the trenches would seriously impair the surface. Consequently, strips of burlap, between 3000 and 4000 running feet in length, and 8 ft. wide, were used to cover the improved roads while the work of trenching was going on.

Central Station
Management, Policies and Commercial Methods

ELECTRICAL DRAINAGE IN ILLINOIS.

During the past five years a motor-driven centrifugal pump has been used to advantage by Mr. C. B. Shedd to reclaim about 500 acres of swamp land near Hyde Lake, in the southern environs of Chicago. After being freed of its standing water by the pump, this land has now become valuable soil for raising timothy hay, some of the crops averaging 6 ft. in height and about 2 tons to the acre. When weather conditions were favorable it has also been possible during several seasons to raise a second crop, although, as is characteristic of timothy, after a year or two the soil becomes partially exhausted and must be turned over before new crops can be sown to advantage. While the acreage referred to is at present used for hay crops, it is being held for manufacturing-site purposes on account of its close proximity to the City of Chicago, which makes it valuable property.

The motor-driven pumping equipment installed comprises a 15-hp, single-phase motor driving through bevel gearing and a vertical shaft a 12-in. centrifugal pump capable of delivering 5000 gal. of water per minute, or about 1 acre-ft. of water per hour. Electrical energy is supplied by the Northern Indiana Gas & Electric Company, of Hammond, Ind. The motor and pump are mounted on a movable platform, and by means of screws the pump can be raised to any desired level. During the wintertime, if necessary, it can be lifted entirely out of the water to avoid freezing. The vertical adjustment of the pump also makes it possible to take water from any level desired.

The pump has now been in use about five years and is operated a number of hours a day during the spring season and following any heavy rainfall that occurs during the summer.

In the low-lying Calumet region, partly in Illinois and partly in Indiana, in which Lake Calumet, Hyde Lake and Wolf Lake are found, the total precipitation amounts to about 33 in. per year. Evaporation removes about 17 in. of this from the surface of the ground, leaving somewhat over a foot of water to be lifted from each acre of the submerged swamp land. At the rate charged for electricity, 8 cents to 4 cents per kw-hour, the annual total cost of freeing the land of this amount of water lifted to a level of 4 ft. is about $1 per acre. In return for this expenditure, however, as pointed out above, the land has been converted from a tract of almost no possible utility, except habitation by frogs, to a good agricultural ground which will later become very valuable industrial property.

The cost of installing the pump complete with motor and with the frame house which shelters it was $1,000. A pole line was also built a distance of one mile to meet the line from the Hammond plant, five miles distant, which supplies energy to operate the motor. After being lifted about 4 ft. from the submerged 500-acre tract, parts of which are several feet below the high-water level of Lake Michigan, the water is discharged into Hyde Lake and thence finds its way through the Calumet River into Lake Michigan.

Mr. Shedd, who made this installation five years ago, declares that the motor-driven pump has given thorough satisfaction in every way and during the entire period of its operation has been free from burn-outs or interruptions of any kind. As the result of his own experience, Mr. Shedd has become very enthusiastic on the subject of motor-driven irrigation as well as electrical drainage. A 3-in. centrifugal pump costing $100, he says, will properly irrigate ten acres. A 6-in. $200-pump will irrigate forty acres, and a 12-in. pump costing $400, like that installed on his tract, will care for 160 acres; in each case the total installation cost is about twice the cost of the pump alone. Such motor-driven irrigation can be used to ad-

vantage not only in arid climates, but also on comparatively fertile and humid ground, as it is realized that the crop output from such territory can be greatly increased by the application of a little water during the dry seasons of the year.

TRIMMING AND INSPECTION OF ARC LAMPS IN PHILADELPHIA.

The trimming of the lamps on the newly erected twin lamp poles in the central section of the City of Philadelphia proved to be quite a problem. As a temporary makeshift a 24-ft. two-section ladder was set on a quadrant, placed in the body of an ordinary express-type wagon and so arranged that the ladder could be swung to either side or made to assume an upright position. This arrangement answered the purpose, but the expense of operation was too great, as it necessitated the services of a horse and driver in addition to the trimmer.

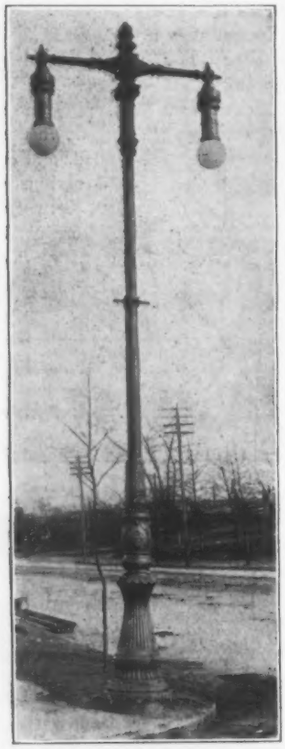


Fig. 1—Twin Arc Post.

The design and construction of an electric tower wagon was then considered, but the main difficulty was to devise a plant to obviate the necessity of having an extra man to do the trimming, as otherwise the driver would be compelled to climb to the top of the tower to trim each pair of lamps. At the suggestion of Mr. A. H. Manwaring, engineer of arc lighting of the Philadelphia Electric Company, a tower wagon was designed that could be operated from either the upper platform or the driver's ordinary position at the floor level and equipped with a turntable at the top to enable the operator to trim the lamps on both the street and house sides of the poles. The Commercial Truck Company, of Philadelphia, collaborated with Mr. Manwaring, and Figs. 2 and 4 show the result of their work.

The tower wagon is constructed on the ordinary 500-lb. chassis, the weight of which without the tower and including the battery is 2600 lb. The weight of the tower is 650 lb., making a total weight of 3250 lb. The vehicle is equipped with a 42-cell, seven-plate Philadelphia storage battery, which will furnish energy to drive the vehicle at an average speed of fifteen miles per hour on the level and has a mileage capacity of thirty miles per charge. The wheels are equipped with 2½-in. x 36-in. Firestone tires, both front and rear. The controller is mounted on the upper platform and can be operated from either the upper or lower seat by a tube outside the steering shaft. The reversing mechanism is a Z-slot bushing keyed on the controller tube, which is worked from the upper seat by the foot and from the lower seat by the hand. The steering gear is mounted in the usual manner and is worked from the upper or lower seat by a shaft which runs through the controller. The brakes can be worked from the lower seat by a foot lever in the usual manner and from the upper seat by a foot-lever rod and crank. The upper foot lever has an extension, so that the operator can set the brakes from the top seat, climb down and release the brakes from the lower seat, or vice versa. The electric bell is operated from either the upper or lower seat by a floor push in the toe-board. The platform is 13 ft. 6 in. from the ground and an additional height can be secured by hanging a portable stand from the side rails, which will increase the height to either 14 ft. or 15 ft. 6 in., depending on which rail is used.

A test of the stability of the machine was made by suspending a weight of 700 lb. from the end of the platform when turned in the position occupied by the trimmer in trimming the lamps (Fig. 4). This test was made before the battery was installed and proved the stability of the tower wagon under the most severe working conditions.

Fig. 2—Automobile Used in Trimming Lamps.

The tower wagon has been giving very satisfactory service, and enables the trimmer to cover each of his routes in approximately six hours, while by the old method nine hours were required to accomplish the same results.

Fig. 3—Ladder Arrangement First Used.

Formerly the inspection of these lamps necessitated the sta-

tioning of a horse-drawn wagon and driver at a centrally located point, and also the use of a motor-cycle, the operator of which covered the district lighted by the ornamental lamps in about four hours. He reported all faulty lamps to the driver, who would proceed to the various locations with the team and start or change the defective lamps.

The tower wagon eliminated the necessity for the horse-

Fig. 4—Method of Trimming Lamps.

drawn wagon and motor-cycle, as by its use all the lamps on ornamental poles are inspected in approximately two and one-half hours and faulty lamps started or changed by the operator, who carries a number of lamps for this purpose on the wagon.

This method of trimming and inspecting the ornamental lamps shows a daily saving in the cost of transportation and labor of approximately 33⅓ per cent over the former method of using the horse-drawn wagon and motor-cycle, and in addition to this the tower wagon has a decided advertising value, as it attracts a great deal of attention on the streets. On one side of the body has been painted "Use Electric Light" and on the other side "Use Electric Power."

WOOD MILLS AS SUMMER MOTOR LOADS.

A distinctly summer load is found in some classes of wood-working establishments. The season of cutting the lumber is closely followed by its preparation in the wood mills, with the result that these places are usually busiest in the summer time, when motor load is most acceptable to the central-station company. In St. Paul, Minn., according to Mr. E. T. Street, new-business manager of the Northern Heating & Electric Company there, there is a planing mill using 250 hp in motors operated by central-station energy. This mill operates sixteen to twenty hours a day in the summer time, almost shutting down in December and January.

On account of the large amount of refuse, useful as fuel, produced in such wood mills they are usually difficult motor customers for the central station to obtain. Mr. J. B. Crane, commercial engineer for the Great Northern Power Company, Duluth, reports, however, that his company is supplying motor service to several sawmills and wood-working plants, and that these actually find that by selling the kindling and shavings formerly burned to make steam they obtain more than enough to cover their electric bills.

Another objection raised by wood-mill proprietors when approached by central-station solicitors on the subject of motor drive is the point that steam is required anyhow the year around for the kilns. In St. Paul, however, Mr. Street reports, there is a mill using 45 hp in electric motors which operates dry kilns all the year. Another planing mill, soon to start operation, has installed 75 hp in motors, using central-station energy in preference to using a steam engine.

In laying out motor drive for a wood-working plant the work to be done must be considered, as well as the rated size of the machines to be operated. For instance, on light work a 5-hp motor will handle very easily a 24-in. planer, while on heavy work a 35-hp motor will sometimes be overloaded when driving a 24-in. planer. Tests show also that dull knives will sometimes increase the power requirements of wood-working machinery as much as 300 per cent. In general, group drive is often desirable in wood-working plants, and this fact does a great deal to simplify the problem of laying out motor drive.

Do not guess at the power required to drive a blower, advises Mr. Street. A fan requiring ¼ hp when operating at 600 r.p.m. will under the same conditions of inlet and outlet apertures require 2.2 hp at 1200 r.p.m. and 11.4 hp at 2000 r.p.m. This illustrates the fact that the power requirements of a blower vary as the cube of the speed; that is, if the speed of a fan or blower is doubled, it will require eight times the original power. For this reason the slowly revolving fan on a ventilating system may be easily driven by a 5-hp motor, while the little high-speed shavings blower may require a 20-hp motor.

Mr. Crane also points out that in replacing steam engines with motor drive in wood shops larger ratings of motors will be required than the engines which they replace. When an engine-driven tool is overloaded by pushing too large material through it the tool simply slows down and the work is withdrawn until the engine has regained its speed. But when a motor-driven tool is worked beyond its rating by too large or too coarse stock the motor strives to hold its speed, simply taking more current to supply the overload. The motor-driven tool thus gives no warning to the unskilled operator that it is being overloaded and is accordingly often pushed far beyond its intended capacity, with the result that the motor may be overheated and destroyed.

COMMERCIAL ELECTRIC HEATING IN NEW YORK CITY.

The extent to which electricity is being employed for commercial electric heating in New York City is quite remarkable, and it is also noteworthy what numerous and varied usages have been the outgrowth of experimenting and developing

Fig. 1—Electric Irons in Garment Manufactory.

along these lines. The installations cited below are typical of many others connected to the New York Edison circuits. The most popular and best known of the heating devices is, of course, the electric iron. This device is now taking the place of every other kind of iron in large cloak and suit, necktie, shirt-waist and other garment-manufacturing concerns in the city. Already the New York Edison Company has nearly 100 large

establishments on Fifth Avenue using flatirons in manufacturing and for pressing samples. In the great garment-manufacturing district, which centers about Twentieth Street, there are hundreds of firms now employing electric flatirons. The reason for their coming into such wide use is that they accomplish 25 per cent more work than any other kind of iron, do it in a more cleanly way, and improve the sanitary conditions of

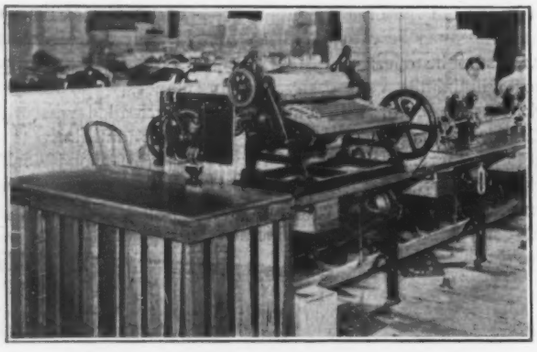


Fig. 2—Electrically Heated Plaiting Machine.

factories where they are used. The weight of the irons for ladies' tailoring averages from 16 lb. to 18 lb., while what is perhaps the largest electric iron is one which weighs 35 lb. and was made for a firm of men's tailors. One of the leading cloak and suit houses has twenty-one irons, an electrically heated plaiting machine and an electric coffee urn, so that employees may have hot coffee with their lunches.

Among necktie manufacturers the electric iron has also taken the place of other devices, a maker of fashionable cravats at Fourth Avenue and Twenty-eighth Street having forty electric irons. Those used for pressing ties average 6½ lb. in weight, but as linen and wash ties require more heat than silk ones, every iron is equipped with a regulating device. As shown in the engravings, a red pilot lamp is connected in multiple with the irons so as to indicate whether the iron is in circuit or not. This signal is provided in conformity with the rulings of the Underwriters.

One of the handicaps which the manufacturers of silk and chiffon waists have had is that of ironing the tucks. By experimenting a novel scheme has been found which does away with the difficulty. A long, narrow goose-iron is riveted upside down

Fig. 3—Electrically Heated Coffee Urns.

to stilts which are set in the table. The tucked material is then passed gently over the face of the iron. This smooths the goods without flattening it. This device was suggested by the heating department of the New York Edison Company.

Another interesting branch of electric heating for commercial purposes that has developed is the use of electric baking ovens by the large typewriter exchanges. These concerns do a large business in second-hand typewriters, many of which they reenamel. In the enameling there is a baking process and it was discovered that the electrically heated oven was just the thing for the purpose. The heat supplied is even and easily regulated to a single degree. The enamel used contains ingredients which

Fig. 4—Electric Irons in a Fifth Avenue Shop.

give off fumes that are to a certain degree explosive. For this reason electricity is much safer than any heating agent which gives off a flame.

A novel use to which the electric iron has recently been put is in the finishing of furniture. A downtown firm found an electric iron the best device for melting composition substance into cracks and nicks in furniture that had become harmed in transportation. The iron smooths off the mended place so well that after the stain and varnish have been applied it is impossible to tell where the repair was made.

Electric glue-pots are used with pronounced success in envelope factories, for very little energy is required to keep the glue at an even melting temperature. Electric soldering irons are now used extensively in the manufacture of leaded glass and metal cornices. They have also been found very handy for the work which has to be done on an electric sign after it is placed on a building. An ordinary soldering iron would cool before it could be passed to the man using it.

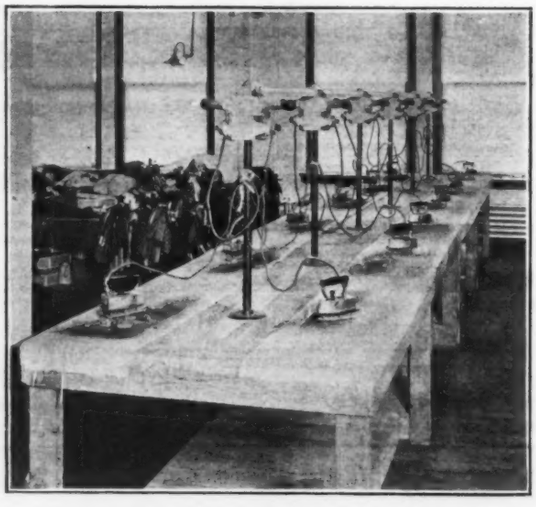


Fig. 5—Electric Irons in Cravat Factory.

In large brush factories where setting mixtures, wax and resin, requiring a temperature of 400 deg. Fahr. to melt, are used, electric pitch-kettles have been installed. In many of the banks and large express companies the sealing wax used is melted in an electric device.

Several of the large moving-picture film manufacturing concerns have found that electric foot-warmers are exceptionally

valuable for keeping the developer and other solutions at the right temperature. This peculiar use of the foot-warmers came about as follows: The Kadem Company, one of the large makers of motion-picture films, sent to the New York Edison Company's heating department for suggestions on some sort of device to keep the chemical solution used in developing films at a uniform temperature of 70 deg. Fahr. To produce the best

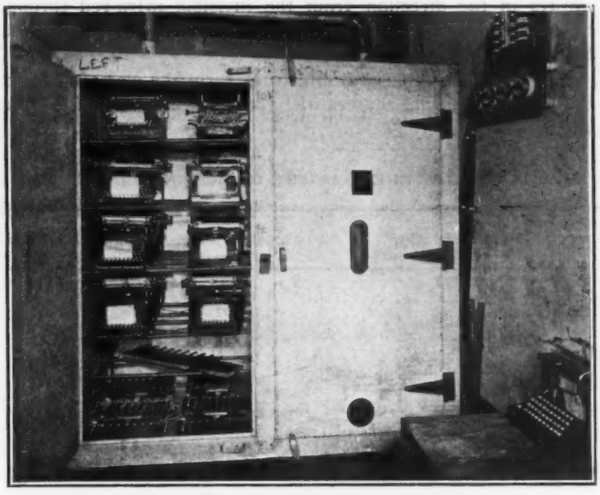


Fig. 6—Electrically Heated Enameling Ovens.

results the developing bath must be kept as near 70 deg. as possible. Hence there is difficulty both in summer and in winter. However, the extra heat in summer has been successfully dealt with by using electric fans. Until recently film manufacturers used kerosene oil in heaters in cold weather, but when the fire-insurance authorities learned of this the manufacturers were informed that any heater with a flame would not be tolerated near the long rolls of celluloid. It was found impossible to use an electric coil, since the acid in the developing solution attacked the copper. Accordingly, the experiment was tried of mounting the trays which hold the solution on electric foot-warmers. The trays are some 15 in. long by not more than 18 in. wide, the developing fluid rising only a few inches in the tank. By placing the foot-warmers underneath the trays at intervals of several feet it has been found possible to keep the solution at the desired temperature.

Wiring and Illumination

NEW TYPES OF ILLUMINANTS.

"New Types of Illuminants" was the subject of a talk by Prof. W. E. Barrows, of the electrical department of Armour Institute, before the Armour Institute Branch, A. I. E. E., April 5. After sketching the history of artificial illumination down through the pine-knot, candle and, finally, to the later forms of gas-mantle units, the speaker took up the subjects of electrical illuminants, describing the construction and principles of operation of the principal arc and incandescent types of electric lamps. Attention was called to the distinction between mere incandescence and the phenomenon of luminescence of which advantage is taken in the newer types of illuminants. An ordinary incandescent substance giving black-body radiations changes in color through red to white with increase of temperature, while, on the other hand, a luminescent material changes in color from the shorter blue wave-lengths to the longer white vibrations with rise in temperature.

Professor Barrows described the operation and construction of the principal kinds of flaming-arc and metallic-flaming-arc lamps. The neon vacuum-tube lamp was also referred to as a possible supplementary unit to compensate for the greenish wave-lengths of the mercury-vapor lamp. The speaker also described the new type of reflector invented by Dr. Peter Cooper Hewitt, the fluorescent material of which converts the short greenish wave-lengths falling upon it into longer reddish vibrations, the complementary relations of the two light sources producing nearly white light. The most highly efficient lamp yet produced, said Professor Barrows, is the quartz-tube mercury-vapor lamp, which has shown a light-producing output of 46 lumens per watt.

ELECTRIC WIRING AND LIGHTING EQUIPMENT FOR NEW BOSTON STOCK EXCHANGE.

A new board-room is rapidly approaching completion for the Boston Stock Exchange, and electricity will play a prominent part in its service. Fifty-two telephone booths equipped with private wires have been installed, and an elaborate telautograph, telegraph, electric fan and lighting service is to be maintained. Although the wiring is concealed, there is to be easy access to every cable through invisible closets in the pillars which carry the principal circuits. The quotation boards are to be equipped for magnetic operation. In place of the present card racks the boards will be provided with magnetized surfaces against which the board boys will place tin cards with iron backs. It is expected that much time will be saved by the arrangement. Elaborate provision is to be made for artificial electric ventilation and lighting, although the building is designed with a large glass dome which will render the use of natural light much more common than in the present quarters of the Exchange.

COMPARISON OF THE OPERATING CHARACTERISTICS OF VARIOUS ILLUMINANTS.

By Isador Ladoff.

The hearth of the hut inhabited by the primitive man was the source simultaneously of heat and light. Light was a by-product of heat. The semi-barbarian used to snatch a chip of burning wood from his hearth to illuminate some particularly dark corner for a short while or to light part of the road of a departing honored guest.

The writer of these lines remembers the "louchina" burning in the windowless, smoky hut of Russian peasants, where the long and thin piece of dry wood was simply stuck into the cracks of the naked timber of the wall. At a somewhat later period wood, pitch and tar were elaborately conglomerated into torches. The candle of a more enlightened age is but an improvement on the torch.

The ancient Assyrians and Egyptians were known to have used liquid vegetable oils in flat dishes in combination with fibrous material, as lamps with a wick. The classical Roman olive-oil lamp was in general use as late as the eighteenth century.

The first step in the direction of a rational utilization of illuminants was made by the druggist Quintet in the year 1765. He was the first to suggest the use of a lamp chimney. The next important step was made by Count Argand, who invented the hollow wick and round burner bearing his name. This happened in 1786.

The light produced by burning wood, pitch, tar, fats, oils or gas is due to the incandescence of the minute particles of carbon. If too little air (consequently oxygen) is finding access to the burning material the combustion is incomplete, the flame is smoky and only feebly luminous. On the other hand, complete combustion, as it is exemplified by the Bunsen burner, produces a comparatively hot, but weak, flame due to the poverty of the latter in incandescent carbon particles. Quintet and Argand struck the happy medium.

In the year 1859 American petroleum was first sent to Europe. This event sealed the doom of the vegetable-oil lamp, and in spite of the progress made since that time in illuminating engineering the petroleum lamp tenaciously keeps its place as a popular illuminant.

The attempt to use the comparatively hot, but non-luminous, alcohol lamp led to the discovery of the Welsbach mantle. Welsbach originated the idea of using incandescent luminous bodies foreign to the flame itself. He was the first to combine "black body" with "selective" radiation in one illuminant.

The first man who manufactured illuminating gas enthusiastically called it "philosophical light." Strange to say, the illuminating gas only slowly gained its popularity as an illuminant. Not until the year 1812 was it introduced in London and not before 1826 in Berlin. In order to maintain the proper degree of incandescence the illuminating gas is subjected to a pressure of from 20 mm to 30 mm of mercury and the flame is spread so as to present sufficient surface. This condition was attained by the Schnitt burner and the Argand burner. This statement applies also to the acetylene gas as an illuminant.

Edison made the carbon-filament incandescent lamp a practical success in the year 1880. The filament gives light as a consequence of electric friction or resistance. There can be no combustion because oxygen is excluded from the interior of the bulb and there is no open flame on account of the absence of incandescent gases. Not until the invention of the differential arc lamp in the year 1879 could the carbon arc be generally adopted as an illuminant.

Beginning with the hearth of the semi-barbarian and ending with the carbon-arc lamp, the actual source of light remained the same, namely, carbon in the state of incandescence. Carbon represents the nearest approach to the theoretical "black body," that is, a body radiating energy in accordance with the temperature to which it is raised. It is but natural that the general tendency of those engaged in the task of increasing the luminous intensities of the sources of illumination was to raise the temperature of the incandescent carbon in one way or another.

In the carbon arc the highest terrestrial temperature so far technically attainable is being utilized. The carbon-arc lamp represents the maximum of luminous intensity attainable with incandescent carbon. In the carbon arc the crater, a small area of the upper positive carbon electrode, is the place where the electro-vaporization or ionization of the carbon is going on. This crater is the principal seat of the illuminating incandescent carbon particles, the arc itself being only feebly luminous because of its considerably lower temperature.

It is an established fact that with the rise of temperature of a body the energy-flow at any wave-length of the spectrum increases and that the increase in energy is the stronger the shorter the wave-length. The maximum of energy-flow consequently moves with the increase of the temperature of a body always in the direction from the invisible infra-red through the visible range into the invisible ultra-violet end of the spectrum.

The following table shows in brief form the wastefulness of the modern artificial sources of light based on the energy value of the fuel used:

TABLE I.—RELATIVE EFFICIENCIES OF MODERN ILLUMINANTS.

Sources of Light.	Watt per Candle.	Relative Efficiency.
Petroleum flame	0.113	0.029
Alcohol flame	0.00092	0.0068
Incandescent gas mantle	0.00183	0.0180
Carbon incandescent lamp	0.083	0.2 to 0.48
Osmium lamp	0.077	0.85
Nernst lamp	0.127	0.3 to 0.34
Carbon arc lamp	0.0215 to 0.0047	

The figures in Table II are not strictly comparable since in some cases the candle-power means the horizontal, in others the spherical, in others the hemispherical, as indicated. The comparative costs of electricity and gas on which the figures are based are, according to the third column, 50 pfennigs=12.5 cents per kw-hour and 16 pfennigs per cubic meter or $1.13 per 1000 cu. ft. of gas. (See Neuerungen in *Der Beleuchtungs-Technik. Zeit. Ingen.*, 1904, 676.)

TABLE II.—COMPARATIVE COSTS OF LIGHT FROM VARIOUS SOURCES.

Source of Light.	Consumption for 100 International Cp-Hours.	Candle-Power Measured.	Price of Fuel or Energy, Cents.	Cost of 1000 Cp-Hours, Cents.
Stearine candle	2.25 lb.	Horizontal	16 per lb.	36.0
Paraffine candle	1.87 lb.	Horizontal	18 per lb.	32.0
Petroleum	0.73 lb.	Spherical	3.2 per lb.	2.33
Petroleum incandescent lamp	0.22 lb.	Spherical	3.2 per lb.	.70
Alcohol incandescent lamp	0.1 gal.	Spherical	19 per gallon	1.90
Gas (ordinary burner)	67.0 cu. ft.	Spherical	113 per 1000 cu. ft.	7.55
Gas (Argand burner)	39.0 cu. ft.	Spherical	113 per 1000 cu. ft.	4.40
Gas, incandescent lamp	7.8 cu. ft.	Spherical	113 per 1000 cu. ft.	.88
Inverted gas incandescent lamp	6.4 cu. ft.	Spherical	113 per 1000 cu. ft.	.72
Acetylene	4.6 cu. ft.	Spherical	700 per 1000 cu. ft.	3.2
Acetylene incandescent lamp	1.2 cu. ft.	Spherical	700 per 1000 cu. ft.	8.4
Electric carbon-filament lamp	350 watt-hours	Horizontal	12.5 per kw-hour	4.4
Nernst lamp	165 watt-hours	Horizontal	12.5 per kw-hour	1.9
Tantalum lamp	165 watt-hours	Horizontal	12.5 per kw-hour	1.9
Osram, tungsten, zirconium, sirius colloid lamps (100 volts)	110 watt-hours	Horizontal	12.5 per kw-hour	1.4
Bergmann, A.E.G., Sonnenlamp, Econo. lamps (220 volts)	130 watt-hours	Horizontal	12.5 per kw-houz	1.6
Electric arc lamp without globe	130 watt-hours	Hemispherical	12.5 per kw-hour	1.6
Electric arc lamp with globe	190 watt-hours	Hemispherical	12.5 per kw-hour	2.4
Inclosed-arc lamp	169 watt-hours	Hemispherical	12.5 per kw-hour	2.1
Liliput lamp	100 watt-hours	Hemispherical	12.5 per kw-hour	1.25
Regina and Reginula arc lamps	88 watt-hours	Hemispherical	12.5 per kw-hour	1.10
Helia arc lamp	55 watt-hours	Hemispherical	12.5 per kw-hour	0.70
Quartz lamp	30 watt-hours	Hemispherical	12.5 per kw-hour	0.37
Bremer, Rebofa flame mercury-vapor lamp	22 watt-hours	Hemispherical	12.5 per kw-hour	0.27
Westinghouse	22 watt-hours	Hemispherical	12.5 per kw-hour	0.27
Beck lamp	21 watt-hours	Hemispherical	12.5 per kw-hour	0.26
Prima flame lamp	17 watt-hours	Hemispherical	12.5 per kw-hour	0.21

Table III, on the next page, shows the ratio between the useful visible and injurious dark radiation in some of the sources of artificial illumination.

The examination of the table reveals the rather startling fact that even the most efficient source of light, the Geissler tube, utilizes only one-third of the total energy in the shape of luminous radiation, while the others fall far behind in their luminous efficiency. Next to the Geissler tube the electrolytic light of zirconium and magnesium oxides, which are selective radiators, shows the highest efficiency.

The color of a source of light to a considerable extent de-

termines its value as a technically important illuminator. Only the following sequence of color, produced by the transversal waves of the ether of certain lengths, affects the animal eye as light: Red, orange, yellow, green, blue, violet. A combination of these waves produces on the eyes the sensation of

TABLE III.—VISIBLE AND INVISIBLE RAYS.

Sources of Light.	Light Rays in Percentage of Total Radiation.	Loss in Percentage.	Authority.
Candle	1.35	98.47	F. J. Rogers
Gas argand burner	1.6	98.42	F. J. Rogers
Welsbach	2 to 4	96 to 98	Strache
Acetylene	5.5	94.5	Angstroom
Zirconium	8.4	91.6	Strache
Magnesium	13.7	86.3	F. J. Rogers
Geissler's tube	34.0	66.0	Merritt
Electric incandescent	6.0	94.0	Merritt
Carbon arc	8 to 12.7	87.3 to 92	Marx
Arc	10 to 16	83.4 to 90	Nakano

white, as, for instance, sunlight. Candles, oil, petroleum and gas appear to furnish yellowish light, while the carbon arc seems bluish. Various incandescent lamps show different shades of color. The reason of this phenomenon is the difference in the intensity of various parts of the spectra of various substances. The following table contains comparative data as to the spectrophotometric values of various illuminants ascertained by Mr. H. C. Vogel (1880). A petroleum lamp was taken as the basis for comparison and the relative brilliancy of the radiation for a wave-length of 555 $\mu\mu$ (yellow) was assumed 100 for both light sources to be compared. The figures of the table consequently show the relative values of the brilliancy of other wave-lengths.

A body whose spectrum is stronger in red, for instance, will appear of reddish tint, while a body whose spectrum is especially strong in the blue part, of course, will show a bluish hue. The best source of light is that which approaches nearest to the sunlight.

In comparing various lamps the cost of trimming must be mentioned. An electrode of long life, for instance, minimizes

TABLE IV.—SPECTROSCOPIC COMPARISON OF LIGHT SOURCES.

Color.	Wave Length, $\mu\mu$	Relation Between Petroleum and the Sun.	Relation Between Petroleum and the Carbon Arc.	Relation Between Petroleum and the Clear Sky.	Relation Between Petroleum and the Moon.	Relation Between the Sun and the Carbon Arc.
Red	633	232	190	398	220	80
Orange	600	175	149	252	164	83
Yellow	555	100	100	100	100	100
Green	517	52	64	40	62	125
Light blue	486	24	43	19	40	159
Blue	444	18	32	9	29	189
Blue	484	11	25	4	22	224
Violet	424	10	20	2	18	

the cost of trimming. The distribution of the light from the source may be favorable and otherwise according to conditions of radiation. It is important to have the illumination so arranged as to throw the major portion of the light where it is most needed. The ordinary carbon-arc lamp, for instance, has a very unfavorable light distribution. This is due to the fact that its most important light-producing part, the crater, is limited to a comparatively small area located on the lower surface of the upper positive carbon electrode, thus allowing the lower negative eletrode to eclipse a great deal of the luminous surface of the crater.

The luminous wave-lengths are contained between 0.008 mm and 0.004 mm (800 $\mu\mu$ to 400 $\mu\mu$). As the velocity of light in the air is 3,000,000 km per second, the number of vibrations of the visible rays is between 750,000,000,000 and 375,000,000,000 per second and embraces one octave.

An ideal source of light is furnished only by luminescent bodies; that is, bodies giving, under the influence of chemical or molecular processes, cold light. Such light is emitted by certain infusoriæ, by rarefied gases and by phosphorescing substances as, for instance, phosphorus and sulphur. Unfortunately the color of such light is bluish or greenish and the luminous intensity exceedingly low. However, there are bodies producing under certain conditions light at a comparatively low temperature; these are called selective radiators. For instance, E. Pringsheim demonstrated (1892) that certain salts introduced into non-luminous flames cause the latter to turn luminous not from any rise in temperature, but from certain purely chemical reactions. No volatilization or dissociation of the substances involved in the process was observed. A mixture of air with CS_2 vapor was proved by Fringsheim to produce a luminous flame with a continuous spectrum, the blue and violet portions of which were rather strong and the temperature of which did not exceed 150 deg. C. This experiment seemed to indicate that luminous vapors may possibly be a promising field of investigation. The question then arose whether gases follow Kirchhoff's law; that is, whether the luminescence starts at a fixed comparatively high temperature or not. It is known that some substances give

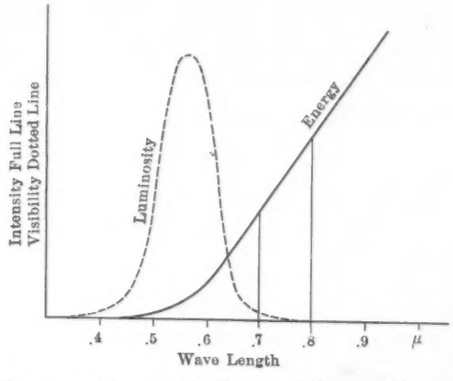


Fig. 1—Energy and Luminosity Curves of Carbon-Filament Lamp.

colored radiation at comparatively low temperatures (thermoluminescence) and consequently do not follow the laws of radiation. Light phenomena are observable during crystallization or when slightly shaken (triboluminescence). Gases may be made to radiate light by fluorescence and electric discharges. Electrification or ionization of a gas is by no means a purely thermal process, but affects the nature of the minutest particles of the gas acted upon.

Our methods of perceiving light and color at high and low intensities are of rather complex nature. At very low illumination the eye acts in a profoundly different way from that characteristic at high illumination, and makes use of an entirely different set of minute organs of the retina. At high illumination we utilize organs known as "cones" and at low illumination a quite distinct variety known as "rods." Consequently the quality of light best adapted to certain purposes is very different in the two cases.

The determination of the amount of energy which the eye must receive in order to experience a certain sensation of brightness is a problem going to the very root of the theory of light production. Indirectly, suitable curves of energy radiation and luminosity of a certain illuminant enable one to calculate the mechanical equivalent of light. For instance, Fig. 1 represents the energy and luminosity curves of a carbon-filament glow lamp as determined by Dr. W. W. Coblentz. The difficulty in calculating the mechanical equivalent of light is that of deciding exactly what range of wave-length can be designated as luminous. One can conclude from the study of Fig. 1 that a great difference in the result would be occasioned by taking the upper limit as 0.8 instead of 0.7. The total light is hardly affected, but the energy is enormously increased.

The problems are very materially affected by the degree of

illumination employed, on whether one is working with weak light and must depend on "rod vision," or with strong light, in which case "cone vision" is used. Intermediate sensations are perceived by the aid of both the rod and the cone vision. Fig. 2 shows the distribution of luminosity in the spectrum corresponding to rod vision, to cone vision and to both combined.

Koenig and Brodhuhn have studied exhaustively photometric

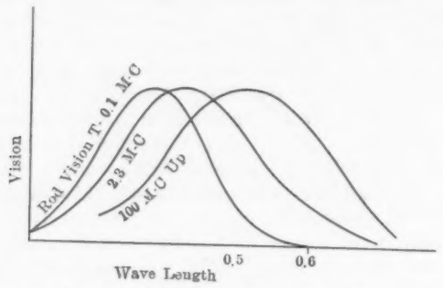


Fig. 2—Distribution of Luminosity in Spectrum.

sensibility, the reciprocal of which is the minimum charge of illumination that the eye is capable of detecting at different intensities. The results of these investigations are shown in Fig. 3. At high illumination the photometric sensibility practically includes all wave-lengths and all intensities.

TABLE V.—ROD AND CONE VISION. VISIBILITY AT VARIOUS INTENSITIES IN METER CANDLES.

Intensities.	0.00024	0.00225	0.036	0.575	2.30	9.22	36.9	147.6	590.4
Ratio to Proceeding		9.38	16	16	4	4	4	4	4
λ =									
0.430	0.047	0.057	0.076	0.060	0.063	0.057	..	..	..
0.450	0.23	0.21	0.21	0.20	0.14	0.10	0.085	..	..
0.470	0.50	0.46	0.42	0.42	0.36	0.19	0.16	0.13	..
0.490	0.85	0.78	0.75	0.70	0.63	0.40	0.28	0.25	0.24
0.505	0.99	0.99	0.98	0.94	0.88	0.63	0.50	0.45	0.40
0.520	0.97	0.96	0.94	0.99	0.97	0.85	0.72	0.69	0.67
0.535	0.75	0.76	0.76	0.83	0.98	0.98	0.91	0.88	0.87
0.555	0.36	0.42	0.47	0.54	0.83	0.97	0.99	0.99	0.99
0.575	0.12	0.17	0.20	0.26	0.58	0.85	0.97	0.98	0.98
0.590	0.045	0.059	0.095	0.15	0.42	0.71	0.88	0.92	0.92
0.605	0.015	0.022	0.044	0.10	0.28	0.54	0.71	0.079	0.79
0.625	...	...	0.022	0.05	0.17	0.05	0.42	0.52	0.54
0.650	...	...	..	..	0.057	0.11	0.15	0.18	0.23
0.670	...	...	..	..	..	0.038	0.050	0 055	0.058
λMax.	0.511	0.511	0.511	0.515	0.529	0.545	0.560	0.565	0.565
Const't	461.	466.	445.	395.	254.	221.	214.	198.	197.
Vo-13 =	1.08	1.16	0.94	0.74	0.31	0.48	1.07	1.00	1.00

In Table VII, in the next column, are given some values of the mechanical equivalent in candles per watt for different wave-lengths.

The study of the metal-lamp filaments, that is, electrical conductors with a high reflecting power in the visible range

TABLE VI.—VISIBILITY AT LOW INTENSITY (ROD VISION).

Wave-Length.	A.B.	E.H.	F.D.	R.R.	E.B.	A.K.	A.H.	E.K.	F.H.	X.P.
0.430	0.015	0.10	0.038	0.062	0.064	0.059	0.047	0.069	0.31	0.089
0.450	0.074	0.30	0.14	0.25	0.21	0.21	0.23	0.23	0.47	0.01
0.470	0.27	0.64	0.31	0.50	0.47	0.49	0.50	0.49	0.74	0.58
0.490	0.57	0.90	0.58	0.74	0.80	0.60	0.86	0.69	0.96	0.84
0.505	...	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00	0.99
0.520	1.00	0.95	1.00	0.85	0.98	1.99	0.98	0.87	0.90	1.00
0.535	0.78	0.77	0.85	0.64	0.74	0.77	0.75	0.66	0.71	0.81
0.555	0.45	0.47	0.49	0.33	0.41	0.42	0.36	0.38	0.44	0.47
0.575	0.20	0.20	0.25	0.12	0.17	0.17	0.12	0.14	0.21	0.13
0.590	0.085	0.076	0.15	0.051	0.067	0.061	0.045	0.071	0.10	...
0.605	0.035	...	0.09	0.022	0.026	0.022	0.015	0.024	0.048	...
λMax....	0.518	0.507	0.521	0.504	0.512	0.511	0.511	0.506	0.502	0.514

and probably reflecting uniformly high in the infra-red, resulted in the discovery of the fact that their distribution of energy in the spectrum is subject to a law similar to that of platinum, but with different constants. One of the principal causes of the higher efficiency of the metal filaments is that they may be run at a very high temperature. The intensity of light increases at the fourteenth power (or thereabout), while the energy per second which must be supplied varies only as the fourth or fifth power of the temperature. Table VIII shows the difference between the true temperatures and the black-body temperatures of platinum, tungsten and tantalum

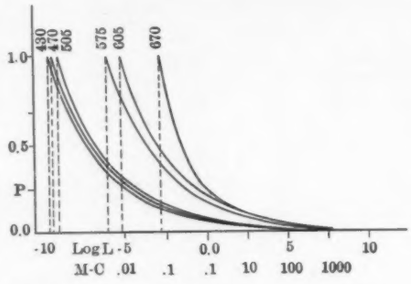


Fig. 3—Curves of Photometric Sensibility.

for different wave-lengths, thereby showing their selective radiation as compared with carbon.

For three wave-lengths used the carbon did not vary at all, while the platinum varied most. Fig. 4 shows the distribution

TABLE VII.—MECHANICAL EQUIVALENT OF LIGHT OF DIFFERENT WAVE-LENGTHS.

Wave-Length.	Watt per Square Centimeter.	Meter-Candles.	METER-CANDLES. Meter-Candles per Watt per Square Centimeter.	Candles per Watt
0.620	0.000162	64	390,000	3.1
0.566	0.000042	64	1,520,000	12.1
0.566	0.000036	61	1,700,000	13.5
0.595	0.000123	182	1,480,000	11.8

of the energy in the visible spectrum from various illuminants using a gas flame as a standard.

The ability of the metallic filaments to withstand higher temperatures than carbon, in spite of the fact that carbon is the most infusible body known, appears to be due to their higher vaporization points. The higher vaporization point, in

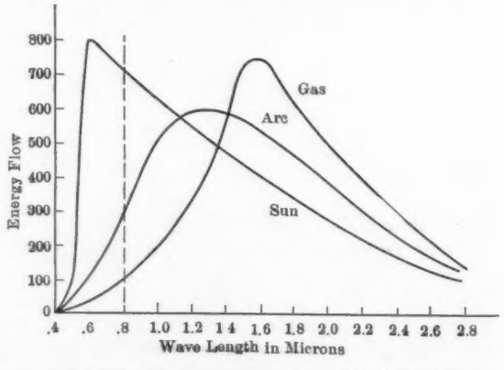


Fig. 4—Distribution of Energy Throughout Spectrum.

its turn, is a function of their high atomic weight (191 for osmium, 183 for tantalum, 84 for tungsten, instead of only 12 for carbon).

In general, the results arrived at in the investigation of Dr. W. W. Coblentz, of the Bureau of Standards, on the selective radiation of various solids show that oxides obey the same laws of the shifting of the maximum of intensity of emission toward the short wave-length. It is remarkable that many

oxides have an emission band in common in the region of 2.8, from which it would appear that this band is due to the oxygen atom which is common with all of them. Especially significant in this connection are the low radiation properties.

TABLE VIII.—TEMPERATURE COMPARISONS.

	True Temperature, Degrees.	BLACK BODY TEMPERATURE:		
		Red. $\lambda=0.66$	Green, $\lambda=0.55$	Blue, $\lambda=0.47$
Platinum	1700	1505	1545	1575
Carbon	1800	1710	1710	1710
Tantalum	1800	1700	1727	1752
Tungsten	1800	1700	1724	1734

of titanium oxide at a temperature of about 1000 deg. C., while the radiation of the same substance in the arc is highly selective. It is also curious to note that the color of metallic titanium is bluish-white, while the color of the rutil arc is rather of yellowish tint, a tint enhanced by increasing amperage. This difference may be due to the difference between the resistivity of these two bodies. Rutil is a better conductor of electricity than is metallic titanium. In the broad sense, the intensity and sharpness of the emission bands are a function of the electric conductivity; the best insulators furnish the sharpest emission bands. The molecular weight of the base seems to affect the sharpness of the bands to as great an extent as does the electric conductivity. With rise in temperature there is a rise in the reflective power and an accompanying increase in electric conductivity of oxides and the spectral emission turns more continuous, as it is found in the Nernst glower. However, the positions of the well-defined maxima of emission are not affected by the change in temperature.

The high emissive power of Welsbach mantles is due to the fact that thoria, coming from its physical characteristics to a high temperature and under the influence of the ceria, which it probably holds in solid solution, acts as a "colored" body having a high selective radiation in the shorter wave-length of the visible spectrum.

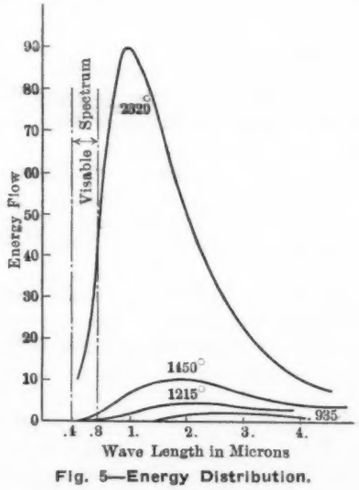


Fig. 5—Energy Distribution.

André Blondel tried in 1900 to employ for his mineralized carbon electrodes rare earths, especially the bodies used in the Welsbach mantles. The results were negative. The flame of the arc was only feebly luminous. Calcium salts the same investigator found to be most useful. These salts appeared yet of reddish color at the temperature of the Bunsen burner, while in the arc their maximum radiation was replaced toward yellow; that is, toward the region most favorable from the physiological viewpoint.

The white chemical combinations of calcium and the bodies nearest related to it, as, for instance, barium, strontium, zinc and berilium, give the best results as mineralizing substances for carbon electrodes. The colored oxides or salts of iron or similar metals give only very weak luminosity. This is not surprising in view of the fact that they approach black bodies in their properties, the electro-vaporization or ionization of which takes place at unfavorable temperatures.

The metallic vapors may be utilized either in vacuo, as in the case of the mercury arc, or in open air, as in the case of the titanium arc. Stark, Kuch and others obtained interesting results with the vapors of lead, bismuth, tin, antimony, sodium, etc. But no technically important application followed. The spectra of the enumerated metallic vapors show no marked superiority in luminous efficiency over the old illuminants. Besides this, the metals require preliminary exterior heating of the tubes containing the metals and a careful control of temperature after the vaporization is started in the tubes.

Iron, copper and other common metals give more or less colored and feebly luminous arcs. Other metals, as, for instance, aluminum, produce oxides of high resistance, extinguishing the arc and keeping it from relighting. The only metallic vapor vacuum arc that has attained some technical importance, namely, the mercury arc, is objectionable on account of the absence of red rays. The degree to which the mercury arc distorts colors may be judged by the data of the following table:

TABLE IX.—COLOR DISTORTION.

Substance.	Natural Color.	Color in the Light of the Mercury Arc.
$FeSo_4$	Bluish green	Colorless.
$CuSo_4$	Blue	Blue (brilliant hue).
$K_2Cr_4O_4$	Yellow	Yellow (brilliant hue).
$K_2Cr_2O_7$	Red	Yellow (dull).
$CoCl_2$	Pale red	Dirty brown.
Cr (No_3) 3	Red	Dark green (turbid).
P	Red	Metallic (dark).

It is obvious that the choice of utilizable substances for increasing luminous efficiencies is rather more limited than it was generally supposed *a priori*. Moreover, as can be seen from Fig. 5, the useful visible part of the spectrum is so small that it cannot even be presented with precision. It cannot surpass 0.1 per cent of the total energy in the red heat and 0.01 per cent at the highest temperature attainable. The relation between the visible and invisible radiation and the total energy varies from 0.02 per cent for petroleum lamps through 0.19 per cent for carbon filaments to 0.32 per cent for the ordinary arc.

RECENT TELEPHONE PATENTS.

IMPROVEMENTS IN CIRCUITS.

One of the better known four-party systems employs what is termed the "braised" bell, which discriminates between impulses of opposite sign. It has been customary to employ a bell of the standard magneto bell design with a spring giving a bias of the armature in one direction. As usually arranged the impulse ringing current is applied to one side of the line at a time, one pole of the generator being grounded. The bells are correspondingly connected between one or the other side of the line and ground. Mr. W. A. Fricke, of Chicago, has devised an improvement in constructing the bells so that they will respond to currents passing through one coil of the winding, but will not respond to currents in the second coil. The bells are bridged and the midpoint between the coils is grounded. It will be seen that if the windings are properly proportioned there will be no unbalancing effect upon a line whether or not some of the stations are omitted.

Another patent granted to this same inventor and, like the preceding, assigned to the Monarch Telephone Manufacturing Company relates to improvements in magneto switchboard. The special features lie in the drops. These have auxiliary

contacts which close a lamp circuit when the drop is energized. The clearing-out drop has a split winding so that a ring-off will not pass the drop when a low-wound bell is connected in parallel with it.

Mr. O. T. Ladermann, of Milwaukee, has invented a circuit for combined telegraph and telephone work. The telephone conversations are limited to the loop between adjacent telegraph stations and are superimposed without interference with or by the telegraph signals. High-frequency telephone ringers are used. The telephones are connected to plugs and each station has a jack connected with the line each way from it. The telegraph relay coils serve to isolate the sections telephonically, while a condenser in the jack circuit keeps the telegraph impulses from the telephone instrument. An adjustable impedance is shunted about the telephone receiver so that any "thump" may be made practically non-interfering.

TELEPHONE ATTACHMENTS.

A telephone receiver holder is the subject of a patent granted to Mr. W. J. C. Kenyon, of Chicago. A flexible tube, such as used in some adjustable lamp stands, forms the arm at the end of which the receiver is mounted. This flexible arm is carried at right angles to an arm which in turn is seated in a base secured to one of the transmitter lug clamping cheeks.

The patent granted to Mr. C. L. Fields, of Rochester, Ind., provides two ear mufflers. These are of felt or other suitable material and one has a closed pocket presented to the orifice of the ear while the other has a tubular passage open at both ends. Both these apertures are tapped by metal tubes which lead to the space within the transmitter mouthpiece and thus while serving to support the muffler also serve as sound conductors. The receiver is held against the open ear muffler. As a further protection from extraneous sounds a special transmitter mouthpiece is used which surrounds the user's lips and contacts all around with his face.

Letters to the Editor.

The Eligibility of "Deceleration."

To the Editor of Electrical World:

Sir:—It seems unnecessary for me to reply at length to Professor Daggett's apology for "deceleration" which appeared in your issue for March 30 in view of my communication on the subject on page 124 of the April *Proceedings* of the American Institute of Electrical Engineers which anticipates and meets completely the points mentioned. Professor Daggett's philological display, though very elaborate, adds nothing to Dr. Steinmetz's. Both confuse partial with complete reversal of meaning. Both fail completely to produce one parallel comparable case. Hence their reasoning is entirely out of phase. It needs better evidence than this to make the word "deceleration" respectable and improve upon the diction of the Roman classics.

If some want to use this word anyhow, right or wrong, it is another matter entirely. All pretence of legitimacy should then be dropped. This word may be forced upon us by might. It can never come into use by right.

My arguments may not be unanswerable, but they are certainly unanswered.

Los Angeles, Cal. C. O. Mailloux.

[The concluding paragraph of the communication to the A. I. E. E. to which our correspondent refers is as follows:

"If anybody had tried to make an educated Roman believe, 2000 years ago, that 'deceleration' is synonymous with 'retardation he would have been ridiculed. The proposition is even more ridiculous to-day. In the first place the problem which the proposed new words were designed and intended to solve does not exist at all, having been solved completely, definitely and satisfactorily over 2000 years ago. In the second place the proposed modern solution is entirely wrong. It is a condition where 'the court has no jurisdiction and the applicant has no case.' The application cannot be entertained. I trust that I have this time justified fully my negative answer to the question whether the words 'decelerate' and 'deceleration' are needed. I may add, however, that before condemning the new words as hybrids I made a very conscientious effort myself to find justification for them. I made a thorough search through the entire series (158 volumes) of the 'Delphini' Latin classics, a work containing all of the best Latin literature, edited and published in the seventeenth century by the best Latin scholars of that day. I have not been able to find anything, either there or in any other Latin work, or in any French work, which would entitle the new words to establish a legitimate pedigree. If any Latin scholar who objects to the verdict rendered against these words wishes to make a more complete search I will gladly place these and other books at his disposal. If he finds any evidence I will be the first to acknowledge it. Until such evidence is forthcoming, however, the proposed words are not, in my opinion, entitled to serious consideration. The appearance of these bogus words in the Century Dictionary is like the appearance of bogus noblemen in fashionable circles. The discovery of their bogus character ought to be sufficient reason, in both cases, to 'put them out.' Men of science are wont to resent and denounce the violation of natural laws; yet they are prone to violate the laws of language, some of which are very natural and entirely scientific. They ought to be the first to appreciate and uphold order and system and to cultivate and encourage good diction; yet they are notoriously most lax in this respect. Let us have reform."—Ed.]

Gas Lamps Versus Indirect Lighting.

To the Editor of Electrical World:

Sir:—The writer was somewhat interested in the deductions appearing in the article by Mr. Albert Scheible on "Gas Lamp Versus Indirect Lighting" in the *Electrical World* of March 30. The conclusion that because the manufacturer of a mirror cone reflector has been unable to adapt his product to gas lamps therefore gas cannot be used for indirect lighting is rather far-fetched. One could as well make the statement that because this manufacturer's reflectors are opaque and consequently would not be satisfactory for many direct-lighting systems using tungsten lamps, therefore electric lighting is as a consequence badly handicapped, having to depend upon translucent opal or prismatic reflectors of lesser efficiency. It has been somewhat generally admitted—perhaps not openly—that the chief incentive to push indirect lighting by central stations is largely due to its claim to inefficiency, a tungsten indirect-lighting installation appeasing both the consumer and the company—the former with the knowledge that he is using the most efficient lamp and the latter with a consumption equal to that of the previous carbon-filament direct-lighting system.

The number of indirect-lighting systems using gas, in the opinion of the writer, is quite as large a proportion of the total gas-lighting installations handled by gas companies as is the proportion in the electrical field and with about the same efficiency when compared with direct-lighting systems, varying from one to two to three to five.

The exponents of indirect lighting are doing good work and have made wonderful strides. There is, however, more of the regular gas-lighting business undeveloped than the lamp manufacturers can take care of before they will have either the time or inclination to devote to indirect-lighting systems, which, to say the least, are more difficult to sell and in a more restricted market. Indirect lighting with tungsten lamps may be more largely a necessity with a filament having a specific brilliancy of 1000 cp per square inch than with a mantle having less than one-tenth that intensity.

"The difficulty of reaching jets in such fixtures for turning

and lighting the gas" is readily overcome. Wall and pendent switches for electric lighting are more expensive, more difficult to install and will generally result in more trouble than any similar means for the control of gas lamps.

The consumption of the pilot flames can be much more clearly stated than by "adding one-third to the yearly charges for lighting." Lamps used six hours daily, 2190 hours per year, should surely not be charged with the same percentage of yearly consumption for pilot flames as lamps used only one hour a week, fifty-two hours per year. Then, again, the 0.1 cu. ft. per hour pilot may be attached to a lamp having a maximum consumption of 2 cu. ft. or a lamp consuming 5 cu. ft. per hour. The 0.5 cu. ft. per hour pilot may be on a lamp consuming 10 cu. ft., 20 cu. ft. or 30 cu. ft. per hour and consequently bear no fixed relation to the yearly costs for gas.

In the writer's home ten pilot flames are used with a meter registration equivalent to 50 cents per month, as shown by actual test. This is a remarkably low cost for night lights in all the rooms and halls and is alone well worth the cost, without considering the convenience of having to use only from two to five matches per month to ignite pilot flames on lamps not used regularly.

For an engineer to refer to heat and vitiation of air in interiors lighted by gas lamps may some day be as popular as it is to-day to refer to a 5-amp inclosed arc as a "2000-cp lamp."

Gloucester City, N. J. NORMAN MACBETH.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Electrolytic Valves for the Compounding of Alternators.—M. C. LIMB.—A French Academy paper. The author formerly showed that an alternator can be made self-exciting by the use of electrolytic valves. From this he concluded later that it is possible to build, at least in theory, not only alternating current generators without exciters, but also direct current dynamos without commutators. In the case of alternators the possibility of avoiding a special exciter is of small importance on account of the small size of this machine. But by means of electrolytic valves a new method of compounding alternators can be effected. The primary of the alternator is provided with two sets of exciting windings, the one producing the principal field and the other being the compounding winding. This compounding winding is supplied with rectified current by means of electrolytic valves from the secondary of a transformer the primary of which is fed from the alternator to be compounded. The author tried this method with a 10-kva, 150-volt alternator and stated that the method worked satisfactorily.—*L'Industrie Elec.*, March 10.

Speed Control of Polyphase Motors.—A note on a recent British patent (25,964, March 23, 1911) of the Siemens Brothers Dynamo Works, Limited. The speed of the polyphase commutator motors is usually varied by altering the voltage applied to the rotor winding through the commutator. According to this invention the control is effected either by maintaining the total of the stator and rotor voltages constant and varying the exciting field or by altering both voltages and field. The former is suitable when the torque decreases as the speed rises, and the latter when the torque decreases with the speed. Various arrangements of the transformer connection between the stator and rotor circuits are described.—Lond. *Elec. Eng'ing*, March 30.

Non-Salient Pole Turbo-Alternator and Its Characteristics.—S. P. SMITH.—This paper in full, an abstract of which was recently noticed in the Digest. The author shows that the non-salient pole alternator possesses the inherent characteristics of a sinusoidal flux and pressure wave under all conditions of load. The best distribution of the winding is ascertained, and it is shown how the flux and pressure waves can be constructed.—Lond. *Electrician*, March 31.

Reactance.—J. REZELMAN.—A continuation of his long serial on synchronous and non-synchronous reactance. The author gives the results of tests of a 75-kva alternator with solid salient poles, and discusses especially the influence of the excitation and the variations of the reactance when the alternator operates as a non-synchronous motor.—*La Lumière Elec*, March 25.

Lamps and Lighting.

Photometry.—In the annual report of the (British) National Laboratory an account is given of further researches in photometry. The last report described the "cascade method," which is being adopted for stepping up from low to high-efficiency lamps in order to minimize the effect of color difference in the comparisons. There has been a difficulty, however, in obtaining high-efficiency metallic-filament lamps which are satisfactory as sub-standards. Several makes of lamps which it was intended to run at 1.5 watts per candle have had to be discarded on account of small but erratic candle-power fluctuations. For the same reason it has been found necessary to supersede the set of 2 watts per candle sub-standards by a new set which have been specially made for the laboratory. This new set of lamps has been independently standardized during the year by six observers against the carbon sub-standards, which run at about 3.5 watts per candle. A similar set of lamps to run at 1.5 watts per candle is now under observation, and if found satisfactory, the chain will be complete for the present as far as high-efficiency lamps are concerned. Experiments are being made, however, with a view to using low-efficiency tungsten lamps as sub-standards, and two sets have been made, burning respectively at approximately 5 watts and 3.5 watts per candle. The former have six filaments and the latter five, giving about 14 candles at 100 volts. One set matches the pentane lamp in color and will be compared directly against it, thus affording another opportunity of reproducing the British unit in terms of the primary standard. The second set will represent the unit in a light of whiter hue.—Lond. *Electrician*, March 31.

Metallic-Filament Lamps.—MONASCH.—A review of the development of the metallic-filament industry in Germany since the first 40-cp, 110-volt tungsten lamp was exhibited in May, 1906. Now there are on the market for 100-volt to 130-volt tungsten lamps of 16 hefner cp, 25 hefner cp, 32 hefner cp, 40 hefner cp, 50 hefner cp, 75 hefner cp, 100 hefner cp, 200 hefner cp, 300 hefner cp, 400 hefner cp, 600 hefner cp, and 1000 hefner cp; for higher voltages up to 250 volts tungsten lamps of 20 hefner cp, 25 hefner cp, 32 hefner cp, 40 hefner cp, 50 hefner cp, 75 hefner cp, 100 hefner cp, 200 hefner cp, 300 hefner cp, 400 hefner cp, 600 hefner cp and 1000 hefner cp. All these lamps can now be used in any position. In 1906 it was regretted that 110-volt tungsten lamps for 10 cp could not be made. They are not being made, however, because there is no real demand for them. In competition with arc lamps the metallic-filament lamp has succeeded in capturing the whole field up to 1000 cp, both for interior and street lighting, while the arc lamp is still supreme above 1000 cp. When tungsten lamps were first introduced it often happened that when a larger number of lamps were switched on the fuses burned out. The reason is that on account of the higher conductivity of the metals when cold the starting current of tungsten lamps is seven or eight times the normal current and the starting current of tantalum lamps is four or six times the normal current, while the starting current of the carbon lamp is 0.7 times the normal current. For the tantalum lamp with its drawn filament the life is not so long with alternating current as with direct current, due to inter-

molecular changes. The same is stated to be true for the new drawn-tungsten-filament lamp, developed in this country. But tungsten lamps with sintered tungsten filaments have practically the same life with alternating current as with direct current. The effects of wave-form and frequency are finally briefly considered.—*Elek. Zeit.*, March 30.

Street Lighting.—A table prepared by H. Tomlinson-Lee and D. Stuart comparing the cost of gas and electric street lighting in twenty-eight English towns and boroughs. The comparison is very much in favor of electric lighting, which is in all cases cheaper than gas. The average figure of the cost of the cp-year is 9.92 cents for electric light and 24.5 cents for gas light. The most extreme case is in Islington, where the cost of the cp-year is 6.26 cents for electricity and 33.12 cents for gas. In this case the majority of electric lamps are arc lamps. At Fulham, however, where 914 incandescent electric lamps and 226 arcs are used, the ratio of the cost of gas and electricity is about the same. The best figure for gas is at Chelsea, where the cost of the cp-year is 11.04 cents, inverted gas burners being used. But even that is higher than the average for electric lighting.—Lond. *Elec. Eng'ing*, March 30.

Generation, Transmission and Distribution.

Speed Regulation of Direct-Current Shunt Motors.—E. W. Short.—An account of observations which the author has made in the use of direct-current shunt motors for driving textile machinery. The tendency of a shunt motor to maintain even speed under all conditions, which might be called its inherent speed regulation, is sometimes not so good as might be supposed. Even if the motor is differentially compounded for perfect speed regulation for all steady loads within the usual limits of output of the machine, or if interpoles are added to allow greater latitude in the brush position or in the working range of the flux, the particular correction which is adopted disappears when the motor is worked on a rapidly varying or intermittent load, and the speed variation may be of considerable importance. Although any given motor may be arranged by rocking the brushes or by differential compounding to regulate perfectly on slowly varying loads quite other effects show themselves when the load is quickly intermittent or rapidly varying. This is due to the mutual induction between the shunt and series-field windings or between the armature and shunt-field windings. Details are given of the behavior of a 35-hp motor on a rapidly varying load. The author does not condemn the use of direct-current motors for textile driving as a whole or for driving machine tools and industrial machinery in general. He says, however, that such a machine should not be employed if it is desired to obtain absolutely constant speed when driving a rapidly varying load.—Lond. *Electrician*, March 31.

Dauphiné-Centre Transmission Line.—J. Reyval.—An illustrated description of the equipment of this 60,000-volt line, which extends from Grenoble to Saint Etienne and which is the first French line in which aluminum conductors are used. This transmission line is an interesting example of the interconnection of two hydroelectric power plants with very different conditions of water supply, inasmuch as the times of highest water in the two plants were different.—*La Lumière Elec.*, March 25.

Electric Driving of Rolling Mills.—A note on a recent British patent (12,265, March 23, 1911) of the British Thomson-Houston Company (General Electric Company of this country). When an induction motor is used for the main drive and a direct-current motor for driving the finishing strand trouble may arise with varying load due to relative speed variations between the two motors. This patent describes apparatus responsive to speed variations of the induction motor for controlling the speed of the direct-current motor so as to maintain a proportionality of speed between the two, and thus prevent the steel from buckling as it passes to the finishing strand. —Lond. *Elec. Eng'ing*, March 23.

Steam Plant.—F. L. Richter.—The first part of an illustrated article on steam-plant exhibits at the Brussels World's Fair. The present instalment deals with boilers, pipes and fittings, and reciprocating engines. The article is to be concluded. —*Elek. Zeit.*, March 30.

Traction.

Rail Bonds.—A note on a recent British patent (30,138, March 23, 1911) of the British Thomson-Houston Company (General Electric Company of this country). In order that a rail bond may be both flexible enough to withstand the constant vibration without crystallizing and breaking and strong enough to withstand impact and abrasion it is constructed of small-gage wires with an armoring of heavy-gage wires. In another form described the body consists of concentric layers of strands increasing in thickness toward the exterior.—Lond. *Elec. Eng'ing*, March 30.

Installations, Systems and Appliances.

Rate System.—E. Chonlet.—A continuation of his illustrated paper on rational methods of charging for electrical energy. The author discusses the system in which the energy for lighting is not measured by meter but a charge is made per kilowatt installed and the power which can be employed at any moment in kilowatts is controlled by a limiting device. The system is found to be excellent for all power plants where the cost of producing a kw-hour is low, such as hydroelectric stations. This rate system is less suitable for steam and gas plants, where the cost of producing a kw-hour is higher. Having thus concluded the discussion of rates for electric lighting, the author takes up the discussion of rates for energy used by motors. The article is to be continued.—*L'Industrie Elec.*, March 10.

Small Central Stations.—A. R. Garnier.—In a continuation of his serial on economical conditions for the operation of small central stations the author deals especially with the utilization of exhaust steam and with the use of town refuse as fuel.—*L'Industrie Elec.*, March 10.

Electric Drill.—P. Schiemann.—An article on electric drills, with special reference to details of construction of a new centrifugal electric drill.—*Elek. Zeit.*, March 30.

Wires, Wiring and Conduits.

Dial Fuses.—An illustrated description of a system of non-interchangeable cartridge fuses and fittings of English make. In one type the non-interchangeability depends both on the diameter and the length, in another type on the diameter only. —Lond. *Elec. Eng'ing*, March 30.

Electrophysics and Magnetism.

Ebonite.—The annual report of the (British) National Physical Laboratory gives an account of an extended investigation of the properties of ebonite. The troublesome deterioration of the surface of ebonite when subjected to light, the surface tending to decompose, with the production of free sulphuric acid, is well known. Samples of many qualities of ebonite were placed under a sheet of glass to protect them from dust and exposed for many months to a north light. The test was made on polished and unpolished surfaces and on surfaces as they are left straight from the tool. A portion of each was covered with a brass disk which protected some of the surface of the material from the action of the light, and the production of acid could be roughly gaged by the gradual discoloration of the brass. The acid, especially in damp weather, is quite visible in the form of drops, and a rough estimate of the relative amount on the surface of the different samples could thus be made by inspection and microscopic examination. It was found that a yellow glass acted as a great protection and that a blue glass had but little effect in retarding the production of free acid. The results of the tests showed differences in the rate of production of acid, but the conclusion was only a negative one, viz., that no quality was found to be free from the production of acid, so that where insulation is of great importance ebonite cannot be relied upon if exposed to strong light. The only entirely satisfactory method of protection is to cover all ebonite where high insulation is required by wood, or opaque glass or other material, leaving holes for the handles required for manipulating the necessary switches and for mak-

ing the electrical connections. A third arrangement which has been successfully adopted is to depend on amberite (an artificial amber made from amber waste) for insulation. The disadvantages of amberite are that it is brittle and expensive, but if necessary it could probably be molded to any required shape. The effect of covering the surface of ebonite with shellac varnish has also been tried, but this has not prevented the production of acid and consequent low insulation resistance. The insulation may be restored by thorough washing, and it has generally been found that the rate of production of acid diminishes and that the trouble lessens with time. In certain qualities of ebonite this is accompanied by a change in the color of the surface, which gradually becomes greenish-gray and which, as far as observation has gone, is electrically as good and more permanent than the polished black new surface. It is quite possible that a satisfactory material might be produced by "aging" the surfaces through exposure to a strong light and by frequent washings.—Lond. *Electrician,* March 31.

Radiant Energy and Matter.—J. J. THOMSON.—An account of the first three of six lectures delivered before the Royal Institution in London. The author discusses in considerable detail Stefan's law of the total radiation, the theory of light pressure and the law of the spectrum of radiation.—Lond. *Electrician,* March 24.

Stretching of a Conductor by Its Own Current.—Two critical letters by F. M. Denton and F. Wenner on C. Hering's recent paper on the stretching of a conductor by its own current.—Lond. *Electrician,* March 17 and 24.

Electrochemistry and Batteries.

Regenerating Old Battery Plates.—A note giving some further details on the method used by a British electric automobile company for regenerating old battery plates. When a battery becomes unfit for further use the negative plates are taken and treated with chloride of sulphur, baked for a short time and reduced electrolytically to eliminate all impurities. They are then in a neutral condition, neither positive nor negative. The plate is, however, it is claimed, more uniform and porous, while the treatment it has received has caused the material to expand and fill up the cracks. These plates are then formed into positives and negatives in the usual way and combined to form a regenerated battery. It is stated that, apart from the saving effected by the regeneration of exhausted plates, the regenerated batteries have a longer life and an efficiency of 10 per cent to 15 per cent higher than the original batteries. The process can be repeated when the regenerated battery is in turn worn out, provided the foundations of the plates remain sound.—Lond. *Electrician,* March 31.

Units, Measurements and Instruments.

(British) National Physical Laboratory.—An account of the annual inspection of the National Physical Laboratory. The new experimental tank for carrying out naval experiments was shown. The electric equipment for towing the paraffine models is described. As to the work proposed for the year 1911 the following information is given: The absolute determination of the ohm by means of the new Lorenz apparatus will be the main feature of the year's work. In continuation of the work on the international ohm, new mercury standards of resistance will be made, and these will include five for the new electrical standards laboratory in Japan, the construction of which has been intrusted by the Japanese government to the National Physical Laboratory. Experiments dealing with the silver voltameter and standard cells will be continued in co-operation with other standardizing laboratories, particularly those of America, France and Germany, with a view to settling certain points left undetermined by the London conference of 1908. In connection with the calibration of wave-meters, which has been in progress for some time, it is proposed to improve the steadiness of the source by the employment of a short-spark method. In the work of iron testing it is hoped that the comparison of methods with the Reichsanstalt and the Bureau of Standards will be completed early in the year. It is proposed to continue the investigation of the power-factors of standard condensers, and to increase the accuracy of the methods by minimizing the residual inductances. A new method for making the measurements will also be tried. Further investigation of the effect of frequency on the capacity determination of the condenser is also desirable. The construction of a subdivided self-inductance coil from 1 millihenry up to 10 millihenries will be completed. It is hoped, in addition, to improve the sources of alternating current at 1000 periods per second and to set up vibration galvanometers of increased sensitivity. The chief work in photometry will be the standardization of new sets of sub-standards which will help still more rigidly to maintain the value of the unit of light. It is intended to continue the investigation on the degree of accuracy which may be expected from ordinary supply meters which are subjected from time to time to railway journeys. An account is given of the chief investigations made during the last year, accounts of which are given in separate abstracts in the Digest.—Lond. *Electrician,* March 24 and 31.

Silver Voltameter.—In the annual report of the (British) National Physical Laboratory it is stated that according to the Bureau of Standards in Washington organic matter in the form of filter paper affects the deposit of the silver in the voltameter. The observations at the National Physical Laboratory confirmed this, and it was found that when pure silver nitrate solutions were filtered through filter paper the contamination was such as to increase the mass of the deposit per amp-second by one part in 10,000. The suspension of more filter paper in the electrolyte, as in the Rayleigh form of voltameter, produced little further effect, and in consequence when the filtered electrolyte was used

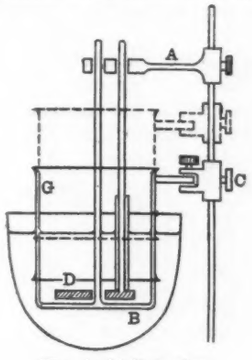


Fig. 1—Voltameter.

in different forms of voltameters substantially equal deposits were obtained. Afterward experiments were made with a voltameter having no septum between anode and cathode. The voltameter devised has an anode in the form of a silver disk *D* (Fig. 1) coated with electrolytic silver. This disk is contained in a shallow glass basin *B* (with ground edge), supported by a glass rod passing through the center of the disk. A glass cylinder *G*, with ground ends, fits over the basin and is used to separate the electrolyte into two parts, before and after electrolysis. Before electrolysis commences *G* is raised until the glass cylinder occupies the position indicated by the dotted lines. At the conclusion of electrolysis the cylinder is lowered into the first position and then disconnected from *C*. By raising the arm *A* the anode, disk, cylinder and contained liquid are removed from the bowl without unduly disturbing the liquid in contact with the cathode. A silver rod supports the disk *D* and is surrounded by a glass tube to prevent considerable electrolytic action at its surface. The experiments made with this voltameter were so satisfactory that a number of the glass vessels were constructed and taken to Washington for the experimental work there.—Lond. *Electrician,* March 31.

Standard Cells.—In the annual report of the (British) National Physical Laboratory it is stated that a large number of Weston normal cells were made during the past year. In connection with the work at Washington sixty new cells were set up in the spring, nine samples of mercurous sulphate and 10 per cent amalgam being used. The maximum difference of e.m.f. between any two of the cells was 0.00003 volt and the mean

e.m.f. agreed very closely indeed with the mean of several hundreds of cells made during the past five years. Thirty-four of the sixty cells were taken to Washington, and a number were left there for comparison purposes. A review of all the observations at the laboratory on standard cells during the past five years leads them to believe that the presence in the cell of a small quantity of free acid is beneficial, as the e.m.f. is more constant, although slightly lower than when the ingredients are acid-free. The results suggest that if part of some freshly precipitated mercurous sulphate is washed in the usual way with concentrated cadmium sulphate solution until apparently free from acid, and a second part is well washed with water, cells containing the two samples will differ in e.m.f. by about four to five parts in 100,000, the cells with the water-washed salt having the higher voltage. If the washing with water is not prolonged the cells containing the water-washed salt appear to remain stable, at least for several years. On the other hand, prolonged washing appears to result in the cells remaining stable for about twelve months, but afterward irregularities become very marked. It appears to be probable that in the majority of the old cells the mercurous sulphate has retained a small quantity of free acid which has been slowly liberated after the cell has been set up, and as a result there has been a gradual fall in the e.m.f. to a steady value. In a few cases the washing has been very thorough, and cells set up with this well-washed mercurous sulphate have e.m.fs. slightly higher than the average e.m.f., and in some instances the cells have become unstable after a few years. A number of experimental cells were therefore made up which contain paste washed in different ways, but a considerable time must elapse before conclusive evidence is obtained. During the visit to Washington a comparison was made of a large number of freshly made standard cells set up at the Bureau of Standards, the Laboratoire Central, the Reichsanstalt and at the National Physical Laboratory. In all eight complete comparisons of these cells were made, the mean differences being as follows:

Laboratory at Which Cells Were Made.	Mean Difference from Mean E.m.f. of All.
B. S.	— 0.000009 volt
L. C.	+ 0.000009 "
R.	+ 0.000000 "
N. P. L.	+ 0.000002 "

The agreement is most satisfactory. The e.m.f. of the Weston normal cell was found to be 1.0183 international volts at 20 deg. C. The provisional value recommended by the London conference was 1.0184 international volts. It has now (Jan. 1, 1911) been agreed by the International Committee to recommend that electrical standardization in the standardizing laboratories of all countries should be based on the value of 1.0183 international volts for the e.m.f. of the Weston normal cell at 20 deg. C.—Lond. *Electrician*, March 31.

Electric Trevelyan Rocker.—W. H. Eccles.—An illustrated description of an electric rocker, the arrangement being shown in Fig. 2. *E* is an ebonite block carrying a stout brass bar *B* and a thin iron wire *F*. These carry the pieces of conductor C_1, C_2 that form the contact. By means of the terminals *A* and *D* a current can be sent through the contact. The circuit usually includes also a potential divider, a telephone and a shunted fiber galvanometer. The apparatus is employed in the following manner: The permanent magnet *M* is pushed toward the iron wire *F* till the contact is just broken, the magnet *M'* being meanwhile at a considerable distance. Now *M'* in its turn is brought toward the other side of the iron wire till the contact is remade—an event that produces a sound in the telephone. By arranging that *M'* is always a fair distance from the iron wire exceedingly delicate adjustments of the contact can be made. In short, *M* is a coarse adjustment and *M'* is a fine adjustment. At some stage of these adjustments the Trevelyan rocker action starts. The best of the common metals for getting the vibrations is lead, and it is well to arrange that C_1 is a plate and C_2 a point. With a suitable current and with occasional adjustment of the magnet *M'* the vibrations can be maintained for an hour at a time. The interruptions produced by the Trevelyan rocker action could in all cases be used for generating high-frequency electrical oscillations in the manner indicated, but they showed no practical advantage over directly driven interruptions. That is to say, the "make" and "break" of the current is not more sudden than occurs in vibrating contacts of the ordinary type of make-and-break apparatus. —Lond. *Electrician*, March 31.

Meters.—An official communication of the Reichsanstalt ad-

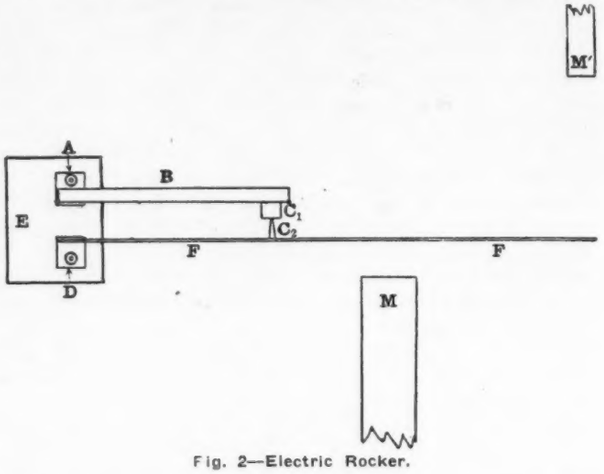


Fig. 2—Electric Rocker.

mitting for calibration an induction meter of the Siemens-Schuckert Company for a balanced three-phase system. This type is a modification of the company's single-phase meter.—*Elek. Zeit.*, March 30.

Proposed International Symbols.—A. P. Trotter.—A letter referring to the recent recommendation to use German script letters for the representation of magnetic quantities. The present author recommends the use as heretofore of the English roman-block type, for instance, B for flux density. In an editorial note on the same subject the hope is expressed that the script letter may be avoided in an international agreement.—Lond. *Electrician*, March 24.

Instruments.—A. Cheneveau.—In a continuation of his illustrated serial on electric instruments at the Brussels Exposition the following instruments of British make are described and illustrated: Oscillograph of Duddell, hot-wire oscillograph of Irwin, single-pivot dynamometer of Paul, reflection electrodynamometer of Sumpner, precision wattmeter of Duddell and Mather, and wattmeter-dynamometer of Nalder Brothers and Thompson.—*La Revue Eelc.*, March 10.

Book Reviews.

The Construction of Graphical Charts. By John B. Peddle. New York: McGraw-Hill Book Company. 109 pages, 58 illus. Price, $1.50.

This is a very useful elementary text-book on the different types of charts used in engineering and their methods of construction. There are so many important methods of presenting natural phenomena graphically on a plane surface that a book of this kind is needed in order to classify and explain them. The book is divided into seven chapters. Chapter I discusses rectangular-co-ordinate charts, including logarithmic scales. Chapter II discusses the alignment chart. Chapter III deals with the alignment chart for more than three variables. Chapter IV deals with the hexagonal index chart. Chapter V treats of proportional charts. Chapter VI relates to graphical determinations of empirical equations. Chapter VII relates to stereographic charts and solid models. The book will be of value to students of applied science in many different fields. It might be improved in a later edition (1) by including more examples from branches of physics other than mechanics and (2) by adding an index.

Annuaire pour l'An 1911. Bureau des Longitudes. Paris: Gauthiers-Villars. 639 pages. Price, 1.50 francs.

This excellent and most comprehensive little volume is devoted this year to astronomical, geographical and meteorological statistics. It is virtually a pocket nautical almanac on this occasion, the chemical and physical sections appearing on alternate years only. A mass of information is offered concerning astronomical phenomena such as a layman would have great difficulty in procuring elsewhere. For example, a tabular list is presented of the principal elements of the orbit of Halley's comet since the year 240 B. C. down to its twenty-eighth repassage last year.

At the end of the volume are certain interesting special appendices. One of these is by M. H. Poincaré on the sixteenth conference of the International Geodetic Association last year in London. Another is by M. G. Bigourdan on the eclipse of the sun to occur on April 12, 1912. It appears that the central line of totality in this eclipse will pass through Paris, or at least through the suburbs of Paris. The volume is a most useful compendium of precise information of an official character as presented by the French government. It offers to the public nearly a million facts for the sum of 30 cents.

Metal Statistics. New York: *The American Metal Market and Daily Iron and Steel Report.* 208 pages.

The 1911 edition of this work contains a larger selection than previous issues of statistical information relating to the metal trades. The statistics cover the production, consumption and price movements of all metal and iron and steel products for a series of years. Among the various copper statistics a table is given showing the total production of this metal for more than 100 years, or from 1800 to 1910 inclusive, which indicates the great strides made by this industry within the last ten years.

New Apparatus and Appliances

SYNCHRONIZING REACTANCE.

One of the most unique features of the municipal plant at Portland, Ill., is the novel synchronizing device furnished by the Fort Wayne Electric Works. Energy is generated and distributed over the city at 2200 volts, transformers being installed at various points to reduce the voltage for lamp and motor service. The series incandescent street-lighting circuit is operated at 4000 volts, this pressure being obtained by means of a step-up transformer installed in the station. One hundred-watt, 4-amp tungsten lamps are used on the street-lighting circuit, there being 134 lamps in series.

The station installation consists of two International Harvester gasoline engines belt-connected to two three-phase, 60-cycle revolving-field Fort Wayne alternators. Each alternator

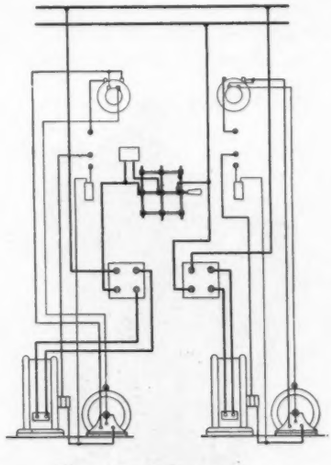


Diagram of Connections.

is connected to operate single-phase and is rated at 25 kva, this rating being 70 per cent of the full-load output when operating three-phase. The excitation for each generator is furnished by a 1.5-kw belt-connected exciter. The two-panel switchboard is provided with the necessary apparatus for the control of the two alternators and feeder circuits. The current regulator which maintains constant current on the incandescent lighting circuit is a standard Fort Wayne product, as is all the electrical equipment in the plant.

The most important feature of this installation is the synchronizing reactance used in throwing the two alternators in parallel. It consists simply of an air-core reactance coil, mounted on suitable brackets on the back of the switchboard. Its operation is as follows: When one alternator is running and it is desired to parallel the other the second machine is brought up to approximately the required speed and connected directly to the busbars in series with the reactance coil. This coil prevents objectionable surging, and by ordinary motor action the second machine is quickly drawn into synchronism, after which the reactance coil is short-circuited by means of a plug switch on the generator panel.

Neither synchronizing lamps nor synchroscopes are necessary with this device and no skill whatever is required in paralleling two machines. With the reactance coil in series with a generator the line switch may be thrown in regardless of the speed of the machine. Even though the alternators be standing still the coil will prevent surges of sufficient amplitude to cause trouble. The device has been in use for some time and it has conclusively demonstrated its ability to parallel two alternators quickly and certainly.

UNLOADING PIG IRON FROM CARGO BOAT BY LIFTING MAGNETS.

One of the interesting applications of the powerful lifting magnets that are now available for service where masses of iron are to be handled is in the unloading of vessels. An example of unusual expedition in work of this character occurred a short time ago at the plant of the Inland Steel Company at Indiana Harbor, Ind. One of the large lake freighters, laden in this case with machine-cast pig iron, was unloaded by means of the lifting magnets between the hours of 7:35 a. m. and 6:35 p. m. of the same day. The manner of handling this pig iron is clearly indicated by the accompanying illustration. The work was done at the ore dock at Indiana Harbor, and as shown in the pictures two magnets were employed. These are of the type made by the Cutler-Hammer Manufacturing Company and each is 62 in. in diameter.

The steamer docked at 7:15 a. m. and work was begun on unloading the pigs of iron at 7:35 a. m. As stated previously the work of unloading was finished at 6:35 p. m. and the steamer cleared at 7:20 p. m., making a very creditable record of a day's performance. The number of lifts of each magnet per hour was normally sixty to seventy, and the total number of lifts of both magnets was 1281. The actual time of unloading was only ten and one-half hours and the total weight of pig iron unloaded was 1960 tons, making the weight of the average lift 3060 lb. The magnets were in practically continuous operation, there being a half-hour intermission between

12 and 1 p. m. which was utilized for oiling and inspection. It may be of interest to add that the length of the boat unloaded is 240 ft., its draft being 15 ft. 3 in. forward and 16 ft. 6 in. aft.

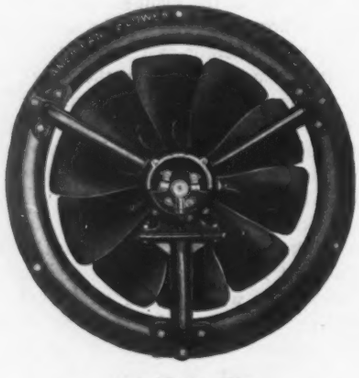
The lifting magnets used for discharging the cargo of iron from this vessel are of the same kind as those successfully used last year for salvaging a boatload of nails, barbed wire, etc., from the bed of the Mississippi River near New Orleans. The advantages of quick unloading and the fewer men required for this arduous work while unloading are entirely obvious.

Magnets Unloading Cargo of Broken Pig-Iron.

HIGH-EFFICIENCY DISK VENTILATING FAN.

The fan illustrated herewith has ten broad blades of the proper dip or curve to produce large volumes freely or against pressures at remarkably high efficiency.

The fan runs at speeds as high as any other fan of the disk type, if not higher, and throws an air current straight ahead. In fact, the air as it leaves the fan has a tendency to bend inward for a considerable distance before it begins to expand. This is said to be contrary to the action of any other disk fan on the market. For example, one of these fans can be set 16 in. away from a hole in a box and discharge more air on the other side of the opening than the fan itself handles, due to the siphon action of the air as it passes through the opening drawing in air along the face of the box.



Ventilating Fan.

It is claimed that the mechanical efficiency of the fan runs as high as 64 per cent, whereas the best of the other types shows a maximum of 25 per cent. This fan has been placed on the market by the American Blower Company, Detroit, Mich.

WASHING AND WRINGING MACHINE.

In the washing and wringing machine built by the American Washer Company, St. Louis, Mo., the clothes are placed inside of a cylinder, which revolves in hot, soapy water automatically

Fig. 1—General View of Washing and Wringing Machine.

and alternately in opposite directions, forcing the water through the clothes, thereby cleansing them without possibility of injury. The cylinders are built of selected wood, reinforced with strips of galvanized iron or brass. The tub ends and sides are made of cypress, and the bottom of the tub of specially galvanized iron or copper, according to the type. The legs are made of oak and the mechanism is held in place by heavy castings, etc. In the "Jewel" washer the transmission is from a motor operated at from 1700 r.p.m. to 1800 r.p.m., connected with a short round belt to the grooved pulley, as shown. This pulley operates the shaft drive. A wide belt on the outside connected with

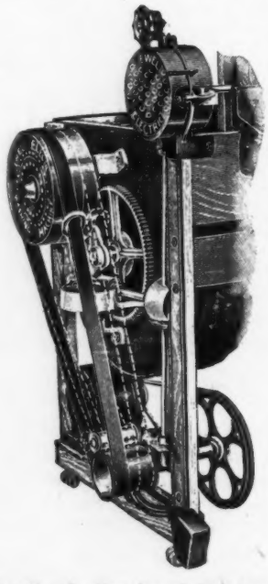


Fig. 2—Driving Mechanism of Washing Machine.

this shaft in turn drives a 1¼-in. flat belt on a triple pulley at the top of the machine. From the same drive shaft at the bottom is extended a direct-shaft drive connected with beveled gears for operating the wringer. From the wringer drive shaft

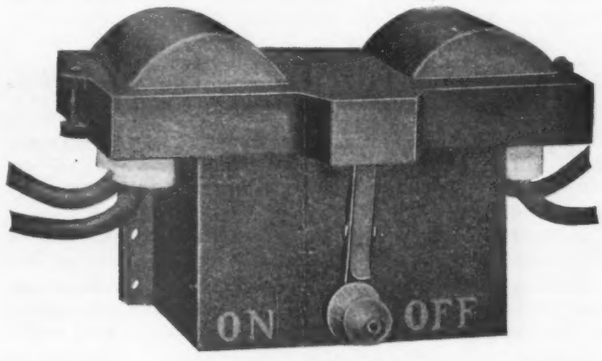
by means of bevel gears a worm gear in the center of the machine is operated, and moves the arm through which the belt runs. This arm moves backward and forward by means of a cam, and shifts the belt from one pulley to another over the center, or idler, pulley, and as the two outside pulleys operate in opposite directions, the proper reverse is made without jar. An automatic belt tightener presses against the lower belt, so as to take up slack and to hold the belt more securely around the pulley. A lever at the top of the machine puts the cylinder gear in and out of mesh. At the top of the wringer will be observed a small hand wheel, a slight turning of which in either direction causes the wringer to operate one way or the other. The wringer and the washing machine can be used simultaneously. The machines are equipped with either alternating-current or direct-current motors suitable for operation on standard circuits.

COMMUTATOR CEMENT.

.The pitting of the mica insulation between commutator segments usually leads to more or less commutator trouble, the hole filling up with copper or carbon dust, which bridges the segments and, being conducting, causes flashover. Troubles of this sort may be avoided if the crevice is filled immediately with an insulating substance. A cement which is said to be very useful for this purpose is manufactured by the Edward E. Early Company, Canton, Ohio. This cement is said to possses high insulating properties and to stay where it is put. In applying it the burned or charred insulation is scraped out thoroughly until clear mica is uncovered, and the compound is then firmly pressed into the hole or crevice and allowed to stand five or ten minutes. The surface is then filed or scraped with sandpaper so as to give it a fine, smooth finish with the rest of the commutator. For quick repairs in large crevices the manufacturer recommends the use of a blow torch to heat the cement until dry. If the motor is not in use, and is not wanted immediately, air drying of the cement is sufficient. The dryer the cement, however, the better its insulating qualities, and it is said not to crumble out due to expansion or contraction, nor to burn, lose its insulating effect or its adhesiveness with red heat.

ARC CIRCUIT CUT-OUT.

The increasing areas covered by systems of electrical distribution introduce many new conditions of operation into the daily work of the central-station administrator. In arc lighting in particular it is important to localize so far as possible the effect of tests on the circuit, since interruptions are measured in actual money deducted from the payments of the city to the company. It is important to be able to cut off sections of the circuit located at situations more or less remote from the generating or distributing plant, and the equipment for this purpose is necessarily designed to permit installation out of doors with operation under load conditions. To meet this demand the High-Tension Electrical Specialty Company, of Newton, Mass., has designed a series arc cut-out which is simple, introduces no complications in the wiring, and on account of the convenient construction of the frame and method of supporting is installed with ease. It can be mounted on a flat surface or, by the use of strap-iron lugs or hooks, placed in service on pole-line cross-arms in the manner of mounting pole-type transformers. This cut-out is entirely weatherproof, being inclosed in a watertight iron casing with detachable cover. The make-and-break contacts are carried in oil, and an external hand switch is carried down the outside of the casing for convenient operation at "on" and "off" positions. When the cut-out switch is set at the "on" position it allows a series circuit to burn. When the cut-out is at the "off" position it short-circuits the line toward the source of supply and leaves the loop or section protected by it absolutely dead, so that the defective loop may be tested by means of a magneto generator with perfect safety and without removing any wires from the box. Any number of these cut-outs may be placed on a long series circuit (double wire) of arc and incandescent lamps, or both, and an open circuit located very quickly by throwing the cut-outs off and testing ahead with a magneto generator. This may be done with the circuit alive, so that when the cut-out is "off" the lamps behind it will at once be placed in service.



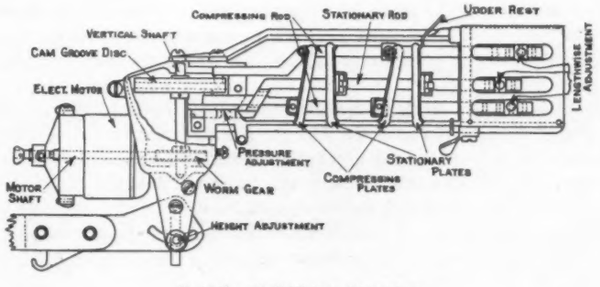
Arc Circuit Cut-Out.

Another valuable feature of these cut-outs is that the break in oil permits "flashing in a loop," which may be open, as shown, by a magneto generator, due to broken incandescent lamps, which frequently happens, as the paper film cut-out does not operate when the circuit is dead at the time the lamp is broken. As is well known, it is often impossible to "flash in a loop" under such conditions with the ordinary air-break cut-out, due to the arcing across the contacts. The fact that such loops may readily be flashed into circuit often saves a great deal of time in restoring service. The cut-out is designed for use on circuits running in e.m.f. as high as 8000 volts.

ELECTRICALLY DRIVEN MILKING MACHINE.

The milking of cows by machine is by no means a new art. It reaches back as far as the early nineties, and a great number of patents have been granted in the United States for mechanical devices designed for this purpose. There are few in actual use, although every intelligent farmer would gladly welcome and pay any reasonable price for a machine that could be depended upon to do the work required without injury to the cows and with adequate saving of hired help and time.

There are two entirely different types of milking machines, one built on the principle of suction and the other on that of



Details of Milking Machine.

pressure produced as in hand milking. The common fault with the suction type is that it is liable to cause injury to the cow, and with the pressure type that it is either not suitable for different sizes of the udder or, if adjustable, is too complicated and easily put out of order.

A new make of milking machine, built upon the pressure principle, has for some time been in use in Europe, the principal features of which machine seem to be the simplicity of

construction together with the minute adjustment rendered possible.

Side views of this milking machine are given in the illustrations, which show that it consists of two sets of stationary members and two sets of compressing members. The plates are covered with pliable rubber and attached to the machine in a way that makes them very easily removable for cleaning. One set of stationary plates is rigidly connected to the middle rod, and the other set adjustable along the same rod for different adjustments for size. The compressing plates are connected to

Fig. 2—Side View of Milking Machine.

the upper and lower rods, one set rigidly and the other set adjustable, corresponding to the stationary members. The adjustment lengthwise is made so that the relative position of the stationary and the compressing member of each set remains unchanged. The two compressing rods end with rollers sliding in a cam-grooved disk. These grooves are made so that the upper edges of the compressing plates first are pressed against the teats near the udder, then swing around the upper supporting points against the stationary plates, ultimately reaching positions parallel to these, and move back with kept parallelism. In order to regulate the pressure the middle rod supporting the stationary plates can be moved lengthwise within certain limits, thus simultaneously altering the relative position of the compressing and stationary plate in each set and consequently the pressure also, the stroke in each case remaining the same.

An electric motor is mounted on the frame of the machine and the power is transmitted from the motor to the cam-grooved disk by means of a worm gear and a vertical shaft. The energy required to drive the machine is somewhat less than that required by an ordinary 16-cp lamp.

It is stated that machines of this construction have been in successful operation for over a year at many dairy farms in Sweden and other European countries, and for the last few months have been tested at the Swedish government agricultural research station at Alnarp, Sweden.

The manufacturer's representative in this country is Mr. A. E. Sylven, 29 Broadway, New York.

SHELL-TYPE BRIM COOLER FOR ICE PLANT.

In the ordinary can type of ice plant racks of ammonia pipes are inserted in the brine between the rows of cans, and in these pipes the liquid ammonia evaporates and expands, chilling the brine, which in turn extracts the heat from the water in the cans.

In an improved "shell-type" brine cooler recently developed a steel container, generally similar to a fire-tube boiler in construction, is used as the ammonia-expansion vessel to replace the ammonia pipes, while through the tubes or flues of this shell the brine is circulated, being chilled as it traverses the tubes. The arrangements for circulating and cooling the brine are well illustrated in the accompanying sectional view of a tank of this kind.

The shell-type cooler was first introduced about two years ago, and has now apparently passed the experimental stage, twenty-four large plants being in successful operation.

Many of the usual ice-tank troubles are due to the expansion coils, and the elimination of these coils secures many advantages of construction and operation.

The cans can be spaced more closely and tank space saved. This also results in a less quantity of brine, less radiating area and fewer heat losses. The absence of coils makes the equipment about 33 per cent lighter, so that it is considerably less expensive to ship and erect. The useful life of cans is also increased, since they are saved the battering against the freezing coils which ordinarily occurs and which is responsible for about 50 per cent of their repairs and renewals. As the shell cooler has fewer parts to keep in repair the maintenance of the entire equipment is considerably reduced.

The rapid circulation of brine possible with the shell-type cooler results in quicker freezing, 300-lb. cans of ice being produced in forty hours. Together with the closer tank spacing, the rapid-freezing action above mentioned accounts for the large output of ice from a given tank capacity obtained with the shell-type cooler.

The conditions under which this system operates also permit a higher back pressure and lower brine temperature than would otherwise be possible, thereby increasing the ice-making capacity without the use of a larger ammonia compressor becoming necessary.

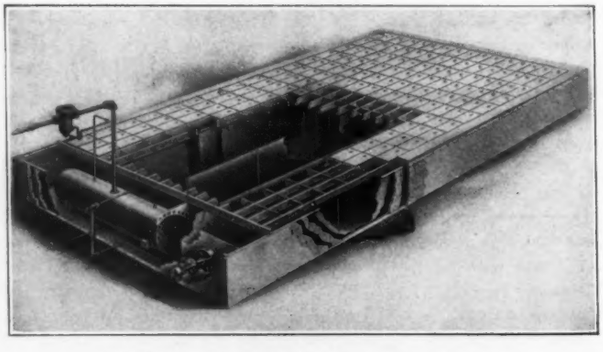
The shell cooler itself is of flanged steel, with heads of somewhat heavier material. Into the heads are inserted special tubes of charcoal iron, the main gas outlet flange, as well as the various connections, being welded into the shell. All joints are welded, and upon completion all coolers are tested to 150 lb. per square inch air pressure under water.

On the outside of the brine tank is placed an ammonia column and a separating device which automatically traps any unevaporated liquor, returning it through a syphon connection to the cooler. This prevents any wet or saturated ammonia from going to the compressor.

Liquid ammonia is permitted to cover just the top row of tubes, the ammonia being loose in the shell, while the brine circulates through the tubes and around the shell, causing the ammonia to evaporate or boil. The accumulated gases pass off at the surface in much the same manner as steam is generated in a horizontal-return tubular boiler. Practically all fittings are eliminated, with the exception of one expansion valve placed above the tank, the liquid being allowed to flow into the cooler at one end at the bottom.

Owing to the large liberating surface there is no difficulty from boiling over or carrying the liquid into the gas as is sometimes experienced with flooded systems.

The ice tank is constructed with specially designed agitator and bulkheads, arranged so that a positive and extremely rapid



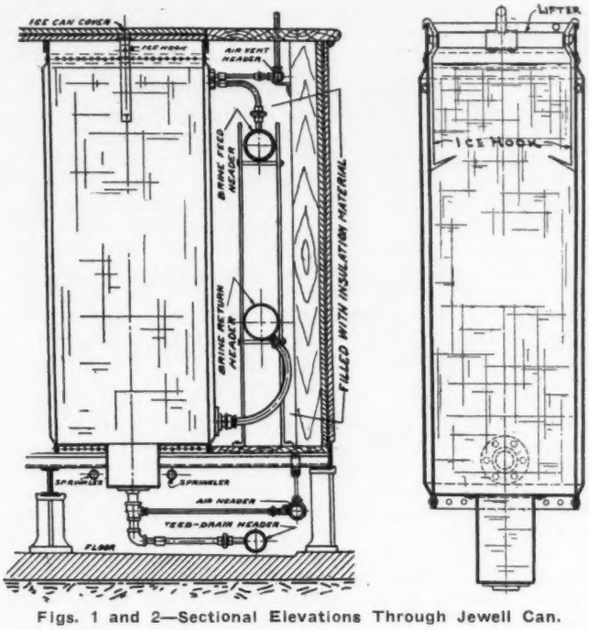
Shell-Type Brine Cooler for Can Ice Plants.

circulation of brine is maintained throughout the entire tank. Owing to the rapidity of the brine circulation a difference of level exists in the various parts of the tank. This is overcome by the use of a special tank top so arranged that the cans are free to rise and fall, and so adjust themselves readily to the variation of the brine level. The cans, however, are always held in a perfectly upright position, insuring square tops to all blocks of ice.

The shell-type cooler described in this article is manufactured by the Triumph Ice Machine Company, Cincinnati, Ohio.

SIMPLIFIED HARVESTING OPERATIONS IN IMPROVED SHORT-CYCLE ICE-MAKING PROCESS.

Cakes of pure, clear ice are made from raw or undistilled water in eighteen to twenty hours by a newly improved can system recently devised by Mr. O. H. Jewell. A number of these plants are already installed and working with good satisfaction, among them being the eight-ton equipment in the Blackstone Hotel, Chicago, a description of which was given in the *Electrical World*, Aug. 4, 1910. The short freezing cycle which it is possible to attain with the Jewell process is of special interest to central-station operators, since with such a system the actual energy-consuming operation of freezing the ice can be completed in about eighteen hours, avoiding the peak period of lighting demand on the electric plant. The ice apparatus can thus be operated on a twenty-four-hour cycle, turning out its full rated tonnage of ice every twenty-four hours, and thus saving the 100 per cent to 150 per cent additional cans, space, tank area, etc., required with forty-eight-hour or sixty-hour ice-making processes.



Figs. 1 and 2—Sectional Elevations Through Jewell Can.

The freezing cans used in the Jewell process differ radically from those of the standard can-type plant. The cans, made of heavy metal, are double-walled, as shown in Figs. 1 and 2, the brine, chilled to a temperature about zero deg. Fahr., being circulated through the hollow jacket spaces thus formed. The cans are mounted stationary in position, and all the operations of filling, freezing, harvesting. etc., are performed without handling the cans themselves, thus conducing considerably to their useful life. After the cake of ice has been frozen the chilled-brine circulation is cut off and warm brine is passed through the can jackets, thawing the ice loose from their sides. Then by means of hooks which, as shown in the illustration, Fig. 2, are previously inserted and frozen into the sides of the cake the ice is hoisted out of the can and carried to the shipping floor or the storage-room. When released the hooks drop freely off the cake. The brine used for harvesting is warmed to about 38 deg. by passing it through the fore-cooling tank, used to cool the raw water preparatory to ice-making, so that in this exchange of heat between brine and water no actual losses of "cold" take place.

The production of clear and pure ice from raw water is the result of a physical action simply described as "the tendency of impure water to freeze itself pure," the foreign matter present being pushed ahead and out of the way of the formation of the ice-crystals. In the Jewell process this action is assisted by agitating the can contents during freezing by a jet of air released from the bottom of the can. The stationary construction of the cans makes it possible to protect this air supply pipe against interruption from freezing by contact with the cold brine or from any other cause. As freezing progresses from each of the four sides of the can, concentrating in the central, vertical unfrozen core of the ice cake all the impurities present, this impure water can be drawn off by opening sewer connections at the bottom of the cans, at once draining off all the collected impurities. By manipulating a second valve, pure, fresh chilled water from the fore-cooler is then admitted to the cans, filling the core holes and freezing them solid. Any number of freezing cans up to fifty are assembled in a single group, and all of the sewer drains and fresh-water inputs for the entire group are controlled from single sewer and inlet valves respectively. In this way the manipulation of the cold and warm brine through the jackets, and the filling and draining of cans, is conveniently controlled from a compact group of several valves, as shown in Fig. 3.

The unique principle in making of the cans simply stationary freezing receptacles thus saves double handling of the cans from the freezing tank to the dump and return, doubtless increasing their useful life.

In case it is not desired to withdraw the impure water in the core of the cake, the foreign matter in this will settle to the bottom after the air supply is cut off, collecting in the non-freezing pocket at the bottom of the can and leaving the ice cake comparatively pure.

The ice cakes produced are of standard weight, from 50 lb. to 400 lb. as desired, but are preferably of thickness not greater than 10 in., to effect rapid freezing in the eighteen hours' time mentioned. An entire plant is divided up into units, each unit producing a fraction of the total plant output. A 5-ton plant is thus divided up into two or three units; a 30-ton plant into six units, etc. The ammonia-expansion apparatus and other equipment used in conjunction with this process are in general similar to those employed in standard ice-making plants, in some instances existing apparatus being readapted for this purpose. The Jewell process freezing-tank equipment is made by the Polar Ice Machine Company, 77 East Jackson Boulevard, Chicago, and is marketed by the Creamery Package Manufacturing Company, ice-machine manufacturers, 61 Kinzie Street, Chicago.

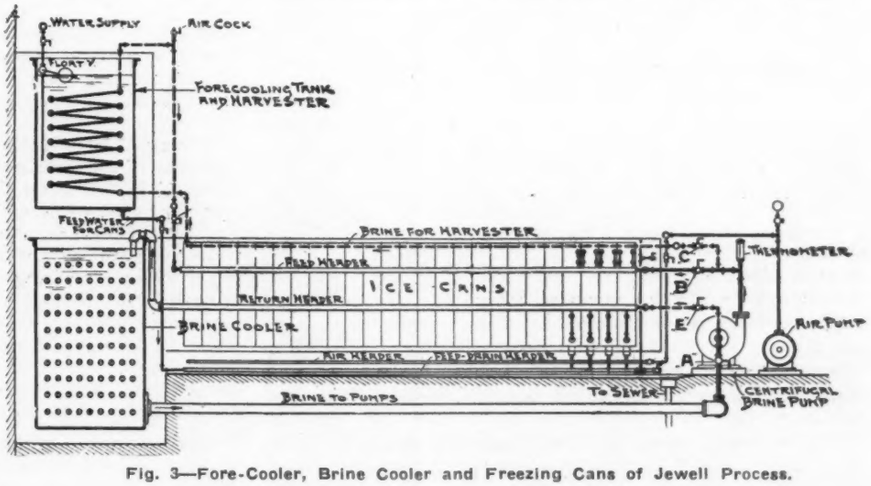


Fig. 3—Fore-Cooler, Brine Cooler and Freezing Cans of Jewell Process.

Industrial and Commercial News

The Week in Trade.

Aside from a slight increase in retail trade due to the Easter season, the dullness in general business has been practically unchanged for the past week. Reports from trade centres throughout the country are not, in the main, indicative of early activity. In the majority of lines demand continues light, and current necessities are the dominant features of interest. General merchandise is reported slightly improved in a few cities of the Middle West. Iron and steel trades are barely holding their own, very few sales of pig iron are being effected, and while the volume of steel trade is undiminished, buying in this line is largely for early delivery. The textile markets are quiet and buyers are holding off for the present, but manufacturers in this field are looking for early improvement. Records of salesmen on the road are only fair, a few increased sales in agricultural implements constituting the principal interest in this quarter. The building trade shows a gain over February business, but is nearly 20 per cent smaller than in March, 1910. Stock markets are listless, and speculation is light. Exports of cotton were less than usual, and while agricultural exports are higher than in March, 1910, they show a falling off from the figures of the four previous years. Weather conditions have been favorable for crops as regards moisture, but continued rain in some sections has delayed planting. Record crop production is expected, and the production of winter wheat is reported as unusually large. Money is abundant. Collections remain slow, and in some quarters requests for extensions are not infrequent. Movements in several lines of trade are affected by prospective changes in tariff schedules. Underlying conditions indicate that activity in general business is not unlikely as soon as present uncertainties can be removed. Business failures for the week ended April 13, as reported by *Bradstreet's*, were 233, as compared with 236 for the previous week, 207 for the same week in 1910, 201 in 1909, 261 in 1908 and 167 in 1907.

The Copper Market.

Demand for copper continues light in all branches of the trade. Wire-drawing and supply interests are not increasing their purchases to a noticeable extent, and the status of the market is reflected in the smaller demand from domestic smelters. Consumption of copper abroad continues to be fairly active, but recent orders for American copper have not been large enough to have any pronounced effect. Conditions at present indicate that the April output will be from 5,000,000 lb. to 10,000,000 lb. less than the March production. These figures are not particularly encouraging when it is remembered that consumption will also be somewhat curtailed, with a net result of increased stock. Owing to small activity on the part of the larger interests in meeting competition prices in this country have declined somewhat, and in Europe there has also been a slight falling off throughout the week. The situation is not attractive and there is little hope that the copper market will reach a rational basis for some time to come. A temporary activity within a few weeks in finished materials is looked for in some quarters, in spite of the fact that domestic consumers in general continue to buy sparingly The electrolytic market is now regarded as being on a 12-cent basis foi the next few months, since attempts to sell for April delivery were met by price shading for May and June shipments. Standard copper continues weak and shows an inclination to decline. Imports up to the Easter holidays were 1165 tons of copper, making a total for the month of 3420 tons. Exports for the month, including April 17, were 11,278 tons. The daily call on the Metal Exchange, April 17, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.60	11.75	.....
April	11.60	11.75	11.67½
May	11.60	11.75	11.67½
June	11.60	11.75	11.67½
July	11.60	11.75	11.67½

The London market, April 17, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	53 15 0	53 13 9
Standard copper, futures	54 7 6	54 6 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.62½c
London, spot	£56 15 0	£53 12 6
London, futures	57 12 6	54 5 0
Best selected	60 5 0	57 10 0

Industrial and Commercial Notes.

Housatonic Power Company Enlarging Plants.—Erection of the additional equipment for the plants of the Housatonic Power Company, New Haven, Conn., is nearing completion. The company operates plants at Beacon Falls, some six or eight miles above Waterbury, a plant at Waterbury and a hydroelectric plant at Bulls Bridge, about thirty miles below Waterbury. A 4000-kw, 2300-volt turbo-alternator, two 1000-kw, 600-volt, six-phase rotary converters, together with transformer and switchboard apparatus, are being furnished by the General Electric Company for the Waterbury plant, and the same company is placing a 300-kw, 6600-volt motor-generator set for railway service at 600 volts direct current in the Beacon Falls plant. This unit is to be a duplicate of two other 300-kw sets already installed. The new turbine is to run in parallel with two 1500-kw, 2300-volt Westinghouse turbine units now in operation at the Waterbury plant. Energy will be generated at 2300 volts, transformed at the plant and transmitted at 6600 volts to the motor-generator sets at the Beacon Falls plant and will be transmitted at 33,000 volts to the 6000-kw hydroelectric plant at Bulls Bridge, with which the Waterbury plant will run in parallel and for which it will act as reserve in the dry season. The new 4000-kw turbine will be condensing on Alberger jet condensers. Additional boiler capacity is also to be provided.

Power Contract for Fall River Electric Light Company.—The Pilgrim Mills of Fall River, Mass., which was recently formed for manufacturing cotton goods, has entered into a contract with the Fall River Electric Light Company for the lighting and motor service in its mill. The plans call for the erection of a 60,000-spindle mill, to cost about $1,000,000, for which contract has been let. The motor installation will be approximately 1700 hp, and about 100 kw will be taken for lighting. The energy to be furnished will be at 40,000 volts primary and 550 volts secondary, three-phase, 60-cycle. Two sources of supply will be provided by the lighting company, both of which will be underground. One is to be a private circuit from the station, and the other a connection to the commercial circuit. Efforts are being made by the central-station officials and the consumer to make the installation modern in every respect. The equipment will be in operation in about one year.

Wiring of New York State Capitol Begun.—Repairs have been started on the New York State Capitol, which was badly damaged in the recent fire. The Tucker Electrical Construction Company, of New York City, has been awarded a contract to put the present wiring system in a safe condition. A large force is now at work in Albany, and will probably be engaged with the rewiring for several months. In addition to the State contract, which is on a basis of cost plus percentage, the Tucker company is doing electrical work for the Tidewater Portland Cement Company at Unionbridge, Md., where about 800 hp in motors will be installed, and has contracts for wiring the new stations for the Fourth Avenue subway, Brooklyn, N. Y., and the St. Luke's Hospital addition.

Westinghouse Equipment for Lumber Company.—The Western Lumber Company, owned by W. A. Clark, of Montana, has closed a contract with the Westinghouse Electric & Manufacturing Company for a 600-kw turbo-generator, together with motors, transformers and switchboards. Other recent sales include equipment for remodeling the switchboards of the main plant and substations of the Augusta-Aiken Railway & Electric Company; additional apparatus for the remote-control switching station of the Eastern Tennessee Power Company, and thirty-two interpole motors to the Public Service Railway Company of New Jersey.

Telephone Train-Dispatching Adopted.—The use of the telegraph has been done away with in the way-station towers of the Middle Division of the Pennsylvania Lines East, which extends from Harrisburg to Altoona. The only telegraph business here consists of through messages between division points. Telephone equipment is now in operation also over the Philadelphia Division, from Philadelphia to Harrisburg. A system of sending out time on the telephone wires has recently been put into effect between Philadelphia and Harrisburg. The system in use is one developed by the Western Electric Company, which has supplied the telephone equipment of these two divisions. At Harrisburg the telephone business of the Pennsylvania Railroad is handled through a central-battery, multiple switchboard with four positions and connected with the lines of the Bell Telephone Company of Pennsylvania. Trunk lines from this board go to Altoona and Philadelphia and to small switchboards located at important points both east and west on the railway's telephone system. Altoona also uses a multiple-exchange equipment of the type used in large operating offices. Two telephone sets are placed in each way-station tower, one mounted on a special transmitter arm, the other an emergency desk-stand telephone with head receiver. Telephone train dispatching has also been adopted by the Duluth & Iron Range Railroad, and equipment is now being installed between Two Harbors and Ely, with a branch from Allen Junction to Virginia and Eveleth, in Minnesota. The new telephone system will cover 123 miles, and there will be fifteen way stations. The officials of this road decided upon this equipment after an investigation of the operation of the telephone circuits on the Great Northern Railway, which for some time has been making extensive use of the selective system of train dispatching.

Philadelphia-Washington Underground Cable.—In order to preclude a recurrence of the conditions that existed on March 4, 1909, when Washington, D. C., was isolated by telephone and telegraph communication by reason of severe weather conditions, the American Telephone & Telegraph Company is building an underground telephone cable between Philadelphia and Washington. When completed the underground conduit will be approximately 135 miles long and will pass through Wilmington and Baltimore. These cities will thus be given the same protection against unbroken communication as will be afforded to Washington. The line from Washington to Philadelphia will be completed in the early fall. The longest commercial telephone circuit wholly underground is between Philadelphia and New York, about ninety miles in length. The plans as projected involve a line wholly underground between Boston and Washington. The construction of the Philadelphia-Washington line has presented many complex problems and required a large amount of equipment of both general and special nature, most of which has been furnished by the Western Electric Company.

Amalgamation of Operation by Telephone Companies.—The directors of the Michigan State Telephone Company elected officers on April 11 at Detroit as follows: President, B. E. Sunny; vice-president and treasurer, Alonzo Burt; vice-president, B. W. Trafford; auditor, B. S. Garvey; engineer, J. G. Wray; general counsel, L. G. Richardson. These changes represent a further step in the standardization of administration among the Bell telephone companies of the Middle West. Three of the officers named, Mr. Sunny, Mr. Garvey and Mr. Wray, are respectively president, auditor and chief engineer of the Chicago Telephone Company. Mr. Sunny is also a vice-president of the American Telephone & Telegraph Company and a director of the Western Electric Company. Mr. Burt is president of the Wisconsin Telephone Company and Mr. Richardson is president of the Central Union Telephone Company. No consolidation of companies is expected, it is said, but there will no doubt be a close working agreement between some of the Bell telephone companies to effect economy in management.

New Factory for Electric Storage Battery Company.—It has just been announced that the Electric Storage Battery Company at Nineteenth Street and Allegheny Avenue, Philadelphia, has closed a contract for the design and construction of a new reinforced-concrete building which will be the largest manufacturing building of this type in the city. This addition to its present plant will be a building approximately 300 ft. long by 115 ft. wide, six stories high, with a one-story triangular extension about 80 ft. x 120 ft. These buildings will be constructed by the patented system of mushroom reinforced-concrete construction, and will be designed to meet the particular demands of this company. These new buildings will be strictly fireproof, and will be provided with the best facilities for the convenience of the employees. The construction of these buildings is to start at once, to be completed during the fall, and will give employment to a large additional force of workmen.

Electrification on the New Haven Railroad.—Thompson, Towle & Company, of Boston, have issued a circular in which they quote an official of the New York, New Haven & Hartford Railroad Company to the effect that within a year the line would be electrically equipped as far as New Haven, and that possibly, also, by that time work would have been commenced on the Boston end of the road. He said that the railroad's engineers are now at work upon the problem of the transportation of freight by electric locomotives with very satisfactory results. As far as the question of economy is concerned, this official said that while the New Haven may not be showing any substantial reduction in operating costs between New York and Stamford by the use of electricity, as compared with steam, the general results to date have more than justified the expenditure.

Electrical Equipment for Danville, Va.—The Riverside & Dan River Cotton Mills, Danville, Va., has placed an order with the General Electric Company for one 200-kw, 600-volt, three-phase generator, one 351-kw, 600-volt, three-phase generator, two 20-kw, 125-volt exciters, three 40-kva transformers, sixteen induction motors of from 10-hp to 100-hp rating, and a 600-volt alternating-current switchboard. The latter consists of one double-circuit exciter panel, one single-circuit lighting feeder panel and one double-circuit feeder panel for furnishing energy to induction motors throughout the factory. The switching equipment consists of hand-operated, remote-control oil switches. A voltage regulator equipment was also ordered.

Wheeler Condensers for Turbine Work.—The New York Edison Company has awarded a contract to the Wheeler Condenser & Engineering Company, of Carteret, N. J., for three surface condensers. These will be furnished with circulating, hot-well and vacuum pumps, and will be used in connection with three 20,000-kw turbines. The condensers are to handle 300,000 lb. of steam per hour, and are said to be the largest of their kind in the world. The Minneapolis General Electric Company has also ordered two surface condensers and auxiliaries from the Wheeler company for the 10,000-kw turbines in its new plant.

Municipal Receipts from Street Railway Operation in Chicago.—The city's 55 per cent of the net earnings of the Chicago Railways Company for last year was less than in the preceding year, the amount being $744,110, compared with $811,776. Notwithstanding this decrease, however, the city's revenue for 1910 from both car companies, through the 55 per cent clause of the ordinance, was much larger than the preceding year, amounting altogether to $1,705,025. The returns from the Chicago City Railway Company were greatly increased because nearly all of the rehabilitation of that company has been accomplished.

Hydroelectric Development in Texas.—It is reported that plans are being formed by David R. Francis, of St. Louis; D. B. Chapin, of Edinburg, Tex., and others for constructing a large irrigation system and hydroelectric plants on the Devil's and Pecos Rivers in the western part of Texas, and that a purchase has been made of most of the land for the irrigation system. The report states that a large dam will be built on each of the rivers, that the hydroelectric plants will have a capacity of about 30,000 hp and that the work will cost in the neighborhood of $5,000,000.

New Warehouse for General Electric Company.—An eight-story building has been erected at Greenwich and Morton Streets, New York City, for the General Electric Company, and will be occupied within a short time as a storage warehouse for reserve equipment of various kinds. Part of the building will be used for the storage of some 500,000 incandescent lamps.

Fire-Alarm Office Equipment.—Kohler Brothers, of Chicago, have been awarded the contract for supplying equipment to the fire-alarm office in the new city hall, Chicago. This order includes generator supporting frame, jumper distributing frame, generator distributing frame and cable terminal units. The amount of the contract is $2,078.

Financial.

The Week in Wall Street.

WITH only 579,106 shares sold, trading on the New York Stock Exchange for the short Easter week showed an appreciable falling off from the low figures of the previous weeks. Final prices show few variations of importance, speculation remains exceedingly quiet, and the few transactions recorded continue to be largely professional. In view of the fact that no Supreme Court decisions were handed down on Monday last, Wall Street is inclined to believe that the rulings will be deferred until autumn, and that activity will be delayed until that time, at least. The larger interests are making no efforts to dispose of their holdings, which serves as an indication that responsible interests are guided by their belief in sound fundamental conditions. The opening of the markets after the holiday recess showed no marked improvement over the dullness of the preceding week. Wall Street depression is spreading to Western centres, and the influence is reactionary in the volume of Eastern trade. Bank clearings are decreasing, building operations are reported as falling off in volume, and railroad purchases are below the usual figures for this period of the year. The effect of prospective revision of tariff schedules is now considered of more importance than evidenced at the opening of the extra session of Congress, and is being felt in many lines of industry, while unsettled conditions on the Mexican border are believed to be exerting an influence toward curtailment of activity, although this is more toward restriction of general trade than stock market transactions. An indication of the amount of funds now idle is the fact that State canal bonds were oversubscribed some ten times the amount of the original issue. Crops are in excellent condition, the foreign trade of the country is improving, and no uneasiness for the future is felt by many Wall Street interests. Several commission houses are quoted as having many large orders for fulfilment in case a break in the market follows the Supreme Court decisions, and plans are said to have been made by large interests for action in case decisions are favorable. Mid-April statements indicate that money will become even cheaper than at present. Rates for April 17 were: Call, 2@2¼ per cent; ninety days, 2¾@3 per cent. The quotations in the table are those of the close, April 17.

NEW YORK.

	April 10.	April 17.	Shares Sold.		April 10.	April 17.	Shares Sold.
All. Ch.....	8*	7½	200	Int. Met., pf.	54*	52⅝	920
All. Ch., pf..	30¼*	29	100	Mackay Cos.	93½*	93½*	———
Amal. Cop...	62⅛	62⅛	11,850	Mackay C.,pf.	77*	76¼	———
Am. D. T...	20½*	20½*	———	Man. Elev...	137	139	210
Am. Loco...	37½	37¼*	960	Met. St. Ry.	15*	15*	———
Am. Loco, pf.	104½	104½*	100	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83*	83*	———	Steel, com...	77¼	76⅝	95,600
Am. T. & T.	145¾	145⅞	3,360	Steel, pfd...	119	120	3,824
B. R. T.....	77⅞	77⅞	2,500	W. U. T....	73	72¾*	600
Gen. Elec...	151½	150½	3,425	West'h, com..	67	65½	300
Int. Met....	19	18½*	1,070	West'h, pfd..	121	117	100

PHILADELPHIA.

	April 10.	April 17.		April 10.	April 17.
Am. Rys.....	44*	44½	Phila. Elec.....	16¼	16¼
Elec. Co. of A.....	11⅞	11¾*	Phila. R. T.....	18⅛	17¾
Elec. St. B'ty.....	53	53¼	Phila. Trac.....	84*	83¾*
Elec. St. B'ty., pfd.	30*	30*	Union Trac.....	46	45¾

CHICAGO.

	April 10.	April 17.		April 10.	April 17.
Chi. City Ry.....	186*	186*	Chi. Tel. Co.....	120	120
Chi. Rs., Ser. 1....	85*	85*	Met. El. Co.....	22⅛*	22⅛*
Chi. Rs., Ser. 2....	23½*	23½*	Met. El., pfd.....	68	68
Com. Edison.....	128	126	Nat'l Car.....	115½	114½
Chi. Subways.....	4¾	4¾	Nat'l Car, pfd.....	120*	120

BOSTON.

	April 10.	April 17.		April 10.	April 17.
Am. T. & T.....	146	145¾	Mex. Tel.....	3½	3½*
Cum. Tel.....	150*	150*	Mex. Tel., pfd.....	6½*	6½*
Edison E., Ill.....	284	284¼	N. E. Tel.....	141*	142
Gen. Elec.....	152	151*	W. T. & T.....	19½	19*
Mass. E. Ry.....	17⅛	16¾	W. T. & T., pfd....	94	94*
Mass. E. Ry., pfd..	88	87			

*Last price quoted.
Shares sold for week, April 10 to April 15.

Financial Notes

United Light & Railways Company.—The new United Light & Railways Company, which has its headquarters in Grand Rapids, Mich., operates public utilities in several cities in the Middle West along lines similar to those of the American Light & Traction Company. It is a Maine corporation and operates and controls by stock ownership all of the properties which have been under the direction of Child, Hulswit & Company for several years, with the addition of two new ones. The properties include the entire gas business of Cedar Rapids, Fort Dodge and Muscatine, Ia.; Cadillac, Mich.; La Porte, Ind.; Mattoon, Ill., and Chattanooga, Tenn. In addition there are three electric plants in Fort Dodge and Muscatine, Ia., and La Porte, Ind. In each of these cities the company has a street-lighting contract. The company also controls the local electric street railway in Muscatine, Ia., and the hot-water district heating system in La Porte, Ind. The company is authorized to issue $12,500,000 of first preferred 6 per cent cumulative stock. Of this amount $2,133,000 is outstanding. It is also authorized to issue $5,000,000 of second preferred 3 per cent cumulative stock, and of this $866,500 is outstanding. The second preferred is used only in exchange for old securities in taking over properties. There is also $12,500,000 of common stock, of which $800,000 is outstanding. The company has no bonded indebtedness of its own, but bonds and preferred stock of constituent companies to the extent respectively of $2,231,500 and $500,000 are outstanding. The operations of the company date from Oct. 1, 1910, and for the five months ended Feb. 28, 1911, the net earnings of constituent companies were $158,114. Deducting from this the fixed charges of the underlying companies and the dividends on the underlying preferred stock of constituent companies, there is left $82,018 as the net profit on the stock of underlying companies. Of this amount there is due the United Light & Railways Company $67,768, while other income brings the total income of that company up to $87,615. When expenses and accrued interest are deducted the net earnings for the period are $67,518. The directors of the United Light & Railways Company are made up largely of men who have invested in the properties taken over. Mr. Frank T. Hulswit is president of the company and Mr. T. J. Weber is consulting engineer. First preferred 6 per cent cumulative stock to the amount of $800,000 is now offered at par and accrued dividends, with a bonus of 40 per cent in common stock, by Russell, Brewster & Company, Chicago brokers

Philadelphia Electric Company Report.—The net results of the fiscal year ended Dec. 31, 1910, show an increase of $67,457 paid in cash dividends and $339,141 added to surplus account, despite the fact that the charge for depreciation was increased $175,000 more than that for the previous year. Gross earnings were $5,946,026; operating and fixed charges, $4,729,647, leaving a net income of $1,216,378. The report shows an increase of 252,296 50-watt equivalents connected at the end of the year. President Joseph B. McCall states that the increasing motor business is especially gratifying, and that the gross income from this source has more than trebled in the past six years, representing at the present time more than 20 per cent of the total sales for all purposes. Contracts have been made to install a 14,000-kw turbine unit and auxiliaries at the Christian Street station and a 5000-kw turbine unit at Tacony, on the Delaware River. Mention is made of the success of the Philadelphia Electric Beneficial Association. Recommendations by the board of directors for the adoption of a "service annuity," or pension plan, based on age and period of service, are embodied in the report.

Texas Utilities Show Improvement.—February reports of the majority of utilities in the principal cities of Texas show substantial increases in earnings over the corresponding period for the previous year. The earnings of the Northern Texas Electric Company, which controls the Northern Texas Traction Company, show a gain of over $16,000, while the increase in net surplus is about $2,000. The company operates an interurban line between Ft. Worth and Dallas, and also furnishes electric light in Ft. Worth. Gross earnings in February for the Dallas Electric Corporation, which owns practically all the electric lighting and street railway properties in Dallas, represent an increase of $15,000, and of $9,000 in net earnings. The Galveston-Houston Electric Company report shows a gain of $10,000 in gross returns, while the net earnings increased about $4,600. A small decrease is shown in the report of the El Paso Electric Company, operating the El Paso Electric Railway, and the El Paso & Juarez (Mex.) Traction Company. The falling off is attributed to the unsettled conditions in Mexico.

North State Hydroelectric Company.—A. C. Wyckoff, H. L. Walker and F. H. Briggs, of Raleigh, N. C., have filed papers of incorporation at that city for the North State Hydroelectric Company, with an authorized capital stock of $300,000. It is said that the new company is a subsidiary of the Carolina Power & Light Company.

Peerless V Belt Company.—Preparations are being made by the Peerless V Belt Company, of Chicago, to broaden its activities. The company is incorporated under the laws of Illinois with a capital of $300,000. A number of capitalists of Cedar Rapids, Ia., have become interested in the company and the main office will be removed to that city, where a modern factory is now under construction. The Chicago office will be removed to the corner of Jackson Boulevard and Canal Street, and there will also be branch offices in New York, St. Louis and several other cities. The company has issued $100,000 in bonds, of which $50,000 has been sold in Cedar Rapids. Treasury stock to the amount of $50,000 is offered to the public at par. The proceeds of this sale will be used in financing the sales department, while the money realized from the sale of bonds in Cedar Rapids will be put into the factory. The company makes a wedge-shaped chain drive, hence the name V belt. Mr. Alphons Gits, formerly of the Western Electric Company, is president of the company.

Detroit Edison Report for February.—Gross earnings of the Detroit Edison Company for February were $287,092, against $231,946 for February, 1909, an increase of $55,146, or 23¾ per cent. Operating expenses were $162,091, an increase of $30,824, the net income gaining $24,322, equivalent to 24 per cent. Interest charges increased $4,953, amounting to $47,580, leaving a surplus after deducting these of $77,421, which represents an increase of $19,369, or 33¼ per cent. During the fiscal year the Detroit Edison Company earned a surplus for dividends equal to 12.33 per cent on the $5,747,000 stock outstanding, comparing favorably with the 8¼ per cent earned the previous year on $5,000,000 stock. The earnings of the company have grown rapidly in the past few years. In 1910 the $3,000,000 mark was reached, while in 1904 gross earnings did not exceed $700,000. It is also of interest that the net earnings for 1910 were in the neighborhood of $1,300,000, contrasted with net earnings of $230,000 in 1904.

United Railways & Electric Company.—At the annual meeting of the stockholders of the United Railways and Electric Company of Baltimore, held last week, the following directors were elected for the ensuing year: H. Crawford Black, Alexander Brown, Frank A. Furst, B. Howell Griswold, Jr., William A. House, George C. Jenkins, Seymour Mandelbaum, H. A. Orrick, John B. Ramsay, Douglas H. Thomas and Francis E. Waters. There were 268,913 shares of the common stock of the company voted at last week's meeting out of a total of 301,000, as against a little over 259,000 at last year's meeting, which was the largest number participating in any previous annual meeting up to that time. Comparing the report of 1910 with 1909, the following is noted: Increase in gross earnings, $477,910.97, or 6.63 per cent.; increase in operating expenses, $240,024.28, or 7.14 per cent.; increase in fixed charges, $82,447.42, or 3.03 per cent; increase in amount carried to credit of profit and loss for the year, $259,803.84.

Report of Rubber Goods Manufacturing Company.—Figures given in the annual report of the Rubber Goods Manufacturing Company for the year ended Dec. 31, 1910, show gross sales of $35,188,295, which is an increase for the year of $9,558,702, a gain of 37.2 per cent over the figures for 1909, and the largest increase in the history of the company. In spite of this large showing, the net profits were $2,122,247, which is a decrease in this item of $247,725. The report attributes the falling off to the fluctuations in crude rubber prices, stating that prices increased from $1.75 per lb. in January, 1910, to $3 per lb. during the year, and dropped at the end of the year to $1.35 per lb., making business operation difficult. Depreciation on rubber stock December 31, 1910, was charged to the amount of $1,000,000. Surplus cash is being used in developing the plants, improving factory operation, and in financing the large tire interests controlled by the company.

Central Hudson Gas & Electric Company.—The Public Service Commission for the Second District, New York, has authorized a consolidation of gas and electric companies which have been merged under the name of the Central Hudson Gas & Electric Company. The merger includes the Poughkeepsie Light, Heat & Power Company, the Newburgh Light, Heat & Power Company and the Hudson Counties Gas & Electric Company. The various companies furnish gas and electricity in Cornwall, Wallkill, New Windsor, Montgomery, Gardiner, Newburgh, Poughkeepsie and other neighboring points in upper New York State. The stocks of the three companies have been held largely under one control heretofore, and the management, interests and territories have been closely connected for some time.

Chicago Engineering Firm in Financial Difficulties.—A creditors' committee headed by Ira M. Cobe is endeavoring to straighten out the affairs of the George W. Jackson Company, Inc., of Chicago, the business being carried on as usual. The corporation was founded and directed by George W. Jackson and is doing an extensive business in engineering contracting. It is asserted that the assets of the company exceed its liabilities and that the trouble has been caused by trying to do too much business on the capital invested. Mr. Jackson is now attending to his contract for building a tunnel at Yonkers, N. Y., in connection with the New York water supply. Mr. Cobe is reported as saying: "The final balance sheet will show a comfortable margin of assets and all proper claims will be met in full."

Yadkin River Power Company Bonds.—A first mortgage to secure $15,000,000 first-mortgage, thirty-year 5 per cent gold bonds has been filed by the Yadkin River Power Company, of Raleigh, N. C., with the Old Colony Trust Company of Massachusetts as trustee. The bonds are payable April 14, 1941, and are in denominations of $1,000 each. The Yadkin River company will take over the unfinished development of the former Rockingham Power Company at Blewith Falls on the Yadkin River, as mentioned in the *Electrical World* March 23, 1911.

Kentucky Electric Company.—First mortgage 5 per cent sinking-fund gold bonds of the Kentucky Electric Company, of Louisville, Ky., to the amount of $600,000 are offered for sale at 97, yielding 5.30 per cent. The bonds are due Feb. 1, 1926, and the company does an electric light and power business in Louisville under a franchise that will outlive the bonds. The net earnings are reported to be more than three times the interest charges.

Northern Ohio Traction & Light Company.—A report of the Northern Ohio Traction & Light Company for the first two months for this year shows an increase of 54 per cent in surplus earnings over those of January and February, 1910. The surplus earnings will produce from 9 per cent to 10 per cent on the common stock if this showing is maintained for the balance of the year.

Earnings of the Edison Electric Illuminating Company of Boston.—The statement of March earnings of the Edison Electric Illuminating Company of Boston shows an increase of $51,771 over those for March, 1909. The increase in operating expenses was $6,648, showing a gain in net earnings for the month of $45,122, or 19.44 per cent.

DIVIDENDS.

American District Telegraph Company of New Jersey, quarterly, 1 per cent, payable April 28.

Binghamton (N. Y.) Light, Heat & Power Company, quarterly, preferred, 1½ per cent; common, ¾ per cent, both payable April 15.

Detroit United Railway Company, quarterly, 1¼ per cent, payable June 1.

Electric Bond & Share Company, quarterly, preferred, 1¼ per cent, payable May 1; common, 2 per cent, payable April 15.

Havana Electric Railway Company, quarterly, preferred, 1½ per cent; common, 1½ per cent, both payable May 13.

Michigan State Telephone Company, quarterly, preferred, 1½ per cent, payable Aug. 1; common, 1¾ per cent, payable June 1.

Sayre (Pa.) Electric Company, quarterly, preferred, 1½ per cent, payable April 15.

United Electric Securities Company, semi-annual, 3½ per cent, payable May 1.

REPORTS OF EARNINGS.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
March,	1911	$471,630	$194,343	$277,287	.....	.....
"	1910	419,859	187,694	232,165	.....	.....

FORT WAYNE AND WABASH VALLEY TRACTION COMPANY.

February,	1911	$253,876	$143,444	$110,432	$91,038	$19,394
"	1910	234,438	129,784	104,654	88.013	16,641

KEYSTONE TELEPHONE COMPANY, OF PENNSYLVANIA.

March,	1911	$95,862	$47,822	$48,040	$24,351	$23,689
"	1910	95,101	47,490	47,611	25,061	22,550

PHILADELPHIA ELECTRIC COMPANY.

Year,	1910	$5,946,026	$4,729,647	$1,216,378	$877,237	$339,141
"	1909	5,489,903	4,287,642	1,202,261	809,780	393,480

UNITED RAILWAYS OF BALTIMORE.

Year,	1910	$7,687,894	$3,601,796	$4,086,098	$2,901,635	$1,286,853
"	1909	7,209,983	3,361,871	3,848,112	2,734,187	1,116,415

General News

Construction News.

MONTGOMERY, ALA.—Contracts will be placed by the Montgomery Traction Company for the construction of a power house in Montgomery in the near future. W. J. Ginnavan, Montgomery, Ala., is manager.

TROY, ALA.—Plans have been prepared by the Standard Chemical & Oil Company for the construction of an electric power plant to develop 1400 hp, at a cost of about $50,000. The plant will be located about 2 miles from Troy and will supply electricity to operate two oil mills and fertilizer plants. Contracts for machinery and equipment have been awarded. It is estimated that the company will save from $12,000 to $15,000 per year by using electric power.

EUREKA SPRINGS, ARK.—The plant and holdings of the Citizens' Electric Company, consisting of electric light and power plant, street railway system, cold storage plant, opera house and large auditorium, have been sold to E. F. Ackerman, of Chicago, Ill.; Hugo Seidel, of Eureka Springs, and others.

ALAMEDA, CAL.—The City Council is considering the question of appropriating $5,000 for the erection of a transmission line to supply electricity to operate the motors on the three drawbridges across the tidal canal.

AUBURN, CAL.—The Board of Supervisors has granted the Great Western Power Company a franchise to erect transmission lines along the Rocklin-Folsom Road.

COACHELLA, CAL.—Plans are being considered by the Coachella Valley Ice & Electric Company for the construction of an ice plant and electric light and power plant to supply electricity in Coachella and surrounding towns. It is understood that bids will soon be asked for the work. W. F. Holt, of Holtville, is president.

JACKSON, CAL.—Preparations are being made for the construction of an electric railway across Amador County to connect Jackson and other towns in the county with Sacramento or Stockton, for which application for a franchise will soon be made. C. P. Vicini, of Jackson; Julius Chihizola, of Amador City; V. Brignola and C. E. Jarvis, of Sutter Creek, are interested in the project.

MARTINEZ, CAL.—The Board of Trustees has granted the Great Western Power Company a franchise to supply electricity for lamps and motors in Martinez for which the company paid $155.

NATIONAL CITY, CAL.—The Board of Trustees is contemplating changing the street-lighting system, using tungsten lamps in place of the present arc lamps.

RIVERSIDE, CAL.—The Pacific Light & Power Company has applied to the Board of Supervisors of Riverside County for a franchise to erect transmission lines on the highways throughout the county. The company proposes to supply electricity for lamps and motors to the smaller towns in the county and to farmers along the route of its line to operate pumping plants.

SACRAMENTO, CAL.—The Citizens' Light & Power Company, recently organized with a capital stock of $2,500,000 and an authorized bond issue of the same amount, proposes to erect a large generating plant and will supply electricity for lamps and motors and also gas in Sacramento. The plant will be located in the Sierras and a substation near Brighton. The company at first will secure electrical energy from the Great Western Power Company. It is understood that George Peltier will be president of the company.

SAN JOSE, CAL.—The Southern Pacific Company is reported to have purchased the entire traction holdings in the Santa Clara Valley controlled by L. E. Hanchett for about $4,000,000. The property includes three extensive electric railway systems.

LONGMONT, COL.—At an election held recently the proposition to issue $46,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, was carried.

GROTON, CONN.—The Board of Water & Electric Light Commissioners is contemplating increasing the output of the municipal electric light plant. The installation of a 500-hp engine is under consideration.

NEW LONDON, CONN.—Sealed proposals will be received at the office of the Constructing Quartermaster, New London, Conn., until April 25 for construction of addition to the water sytem at Fort H. G. Wright, N. Y., including two reinforced concrete pump houses, two electrically driven centrifugal pumps, water mains and reinforced concrete storage reservoir. Plans may be secured from Captain F. T. Arnold, Constructing Quartermaster, New London, Conn. A deposit of $10 will be required for plans.

WASHINGTON, D. C.—Sealed bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until May 1 for furnishing 830, more or less, lamp standards and accessories of special design. Specifications, drawings and form of proposal may be obtained on application to the property clerk, Room 320, District Building, Washington, D. C. A deposit of $10 will be required for plans, which will be refunded on return of same.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of District of Columbia, Washington, D. C., until April 25, for furnishing 2800 ft. of armored submarine cable and 3200 ft. lead-covered cable. Form of proposal, specifications and other information may be obtained on application to the property clerk, Room 320, District Building, Washington, D. C.

FAIRBURN, GA.—Plans are being considered for the construction of a municipal electric light plant in Fairburn, to cost about $10,000. Bids for construction of plant will be called for about May 1. W. B. Green is city clerk.

JACKSON, GA.—The Georgia Power Company is reported to be contemplating the construction of an electric railway from Montezuma, via Oglethorpe to Miona and Reynolds, Ga.

BOISE, IDAHO.—Bids will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 27 for furnishing electrical apparatus for the Boise project, Idaho. For further information address the above office or United State Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

BOISE, IDAHO.—Proposals will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 26 for furnishing hydraulic turbines for the Boise project, Idaho. For further information address the above office or United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

ALBION, ILL.—H. H. Knipe, of Robinson, Ill., is reported to have been granted a franchise to construct and operate an electric-light plant in Albion for a term of thirty years. The city has entered into a contract with Mr. Knipe for lighting the streets and public places of the city, under the terms of which it is to pay $1,207 per year for the service.

BARRY, ILL.—The electric and milling plant of the Barry Milling & Grain Company, of Barry, Ill., was destroyed by fire recently, entailing a loss of about $30,000.

DECATUR, ILL.—The Decatur Railway & Light Company is contemplating improvements to its system in Decatur this year, which will involve an expenditure of about $50,000. It is understood that new lines will be erected.

EAST ST. LOUIS, ILL.—The East St. Louis Light & Power Company is reported to have filed a mortgage of $145,000 in favor of the Mercantile Trust Company of St. Louis, Mo., to secure funds for enlarging its plant. Among the improvements contemplated by the company is the installation of new lamps to be placed on Broadway, Collinsville and Missouri Avenues, at a cost of about $40,000.

GIBSON CITY, ILL.—Two propositions have been submitted to the City Council asking for franchises to supply electricity for lamps and motors in Gibson City. The Gibson Electric Light & Power Company, which has been making improvements to its service, has asked for a renewal of its present franchise. Messrs. Clark and Gleason, said to be salesmen of the Western Electric Company, of Chicago, Ill., have asked for a franchise to supply electricity in this city, agreeing to install a new plant to cost about $50,000 and to supply electrical service at a more favorable rate than is now being given.

LEXINGTON, ILL.—It is reported that the property of the Lexington Electric Light Company is to be sold at a sheriff's sale, the court dismissing the suit of A. J. Scrogin, of Lexington, to replevin the property.

QUINCY, ILL.—The Quincy Gas, Electric & Heating Company has been granted a new franchise for a term of thirty years. The company is contemplating placing its wires underground in the business district of the city.

SEARS, ILL.—The Village Council has granted the Peoples Power Company, of Moline, Ill., a franchise to supply electricity in Sears for a term of thirty-two years.

SHELBYVILLE, ILL.—Plans are being considered for the installation of the park lighting system in the business district of the city. The plans call for the erection of seventy-two ornamental lamp standards, each carrying five lamps.

STERLING, ILL.—The proposition submitted by John T. Mooney to install an ornamental lighting system in the business section of the city has been accepted. The contract calls for the installation of ninety ornamental lamp posts, with wiring and lamps, for $4,250.

WASHINGTON, ILL.—The Peoria Gas & Electric Company, of Peoria, Ill., is reported to have applied to the Council for a franchise to supply electricity in Washington, Ill. The company proposes to erect a transmission line from its plant in Peoria to Washington to supply the service.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company will place contracts for the construction of a new power plant during the next few weeks. The company expects to purchase equip

ment, including 1000 hp in boilers, stokers, a 200-ft. smokestack, coal-handling apparatus and other apparatus for its power plant in Kokomo.

SHOALS, IND.—It is reported that plans are being considered for the construction of a municipal electric light plant, bids for which will be asked about July 1. F. W. Bateman is city engineer.

CENTRAL CITY, IA.—It is reported that Fred J. Cross, of Monticello, Ia., is planning to erect a power plant to supply electricity for lamps in Coggon, Central City, Center Point, Walker and Springville.

DECORAH, IA.—It is reported that plans are being prepared by Chicago capitalists for the construction of a dam to develop 600 hp. Electricity generated at the plant will be transmitted to Waukon, Potsville, Lansing and other towns.

DUBUQUE, IA.—It is reported that the Dubuque Packing Company is building a new packing plant. It is understood that about $20,000 will be expended for new machinery, which will be equipped for electrical operation.

DUBUQUE, IA.—The Flick-Ziepprecht Box Company, of Dubuque, is reported to be erecting a new building to cost about $15,000, which will double the output of the plant. An electric lighting system and new machinery will be installed.

EDGEWOOD, IA.—It is reported that W. Ageton, representing the Ames Iron Engineering Company, is making investigations in Edgewood with a view of establishing an electric-light plant in this town.

FT. DODGE, IA.—Negotiations have been closed for the purchase of a site on the Des Moines River, 10 miles north of Ft. Dodge, for the erection of a large hydroelectric power plant. The proposed plant will cost approximately $612,000 and will supply electricity for lamps and motors in Ft. Dodge, Des Moines, Webster City and Boone, Ia. E. T. Meredith, president of the Des Moines Commercial Club. J. R. Martin and Geis Botsford and others are interested in the project.

KEOSAUQUA, IA.—J. A. Johnson is reported to have been granted a franchise to install and operate an electric light plant in Keosauqua, Ia.

MANILLA, IA.—It is reported that the proposition to grant a franchise for the installation of an electric light plant in Manilla will be submitted to a vote of the people.

MOUNT PLEASANT, IA.—It is reported that plans are being prepared by the Iowa Power Company for the construction of a hydroelectric power plant on Skunk River, bids for which will be called for about May 1. The cost of the work is estimated at about $350,000. The W. H. Rosecrans Engineering Company, Stock Exchange Building, Chicago, Ill., has charge of the engineering work.

MOUNT VERNON, IA.—The Iowa City Light & Power Company is reported to have purchased the plant and holdings of the Mount Vernon Electric Light Company. It is expected a day service will be established and it is probable that the company will ultimately supply electricity to operate an interurban electric railway extending from Mount Vernon to Cedar Rapids.

OSCEOLA, IA.—The Osceola & Southwestern Railway Company, recently incorporated, is reported to be contemplating the construction of an electric railway to Lacelle and Hopeville.

SPIRIT LAKE, IA.—The installation of an ornamental street lighting system in the business district of Spirit Lake is reported to be under consideration.

GREENSBURG, KAN.—It is reported that bonds to the amount of $15,000 have been voted, the proceeds to be used for the construction of a municipal electric light plant.

HORTON, KAN.—At an election held April 4 the proposition to issue $25,000 in bonds, the proceeds to be used to establish a municipal electric light plant and water works system in Horton, was carried. B. B. Morris is city clerk.

KANSAS CITY, KAN.—Preparations are being made to begin work on the construction of the proposed municipal electric light plant in Kansas City, Kan., for which bonds to the amount of $350,000 have been voted.

JEFFERSONTOWN, KY.—Announcement has been made by W. J. Semonin, president of the Commercial Club, of Jeffersontown, that plans have practically been completed by Louisville capitalists for the installation of an electric light and power plant in Jeffersontown. The plant is to be exempt from taxation for ten years.

LOUISVILLE, KY.—Plans are being made for the construction of the new Henry Watterson Hotel in Louisville to cost about $650,000. The plans include electric light, power and refrigerating plants.

LOUISVILLE, KY.—It is reported that plans are being drawn by Fred Erhart, of Louisville, Ky., for an addition to the Capitol Hotel, Louisville, to cost about $20,000. The improvements will include electric light and ice plants.

LOUISVILLE, KY.—A permit has been granted for the construction of the new power house to be erected by the Kentucky Electric Company on Water Street, between Second and Nelson Streets. The building will be 134 ft. x 110 ft., and will cost about $100,000.

LOUISVILLE, KY.—It is reported that plans have been prepared by the Schoppenhorst Dry Cleaning & Dyeing Company, Tenth and Grayson Streets, Louisville, Ky., for installation of an electric power plant to cost about $10,000. Individual motors were recently installed by the company to operate its machines.

NORTONVILLE, KY.—The Norton Traction Company, recently incorporated, is planning to build an electric railway in Nortonville. The company is capitalized at $100,000. Frank E. Hoge, of Nortonville, Ky.; Frank E. Mohr, of Columbus, Ohio, and T. F. Callard, of Hopkinsville, Pa., are interested in the company.

VASSALBORO, MAINE.—The capital stock of the Vassalboro, China, & Windsor Light & Power Company has been increased from $10,000 to $150,000.

BALTIMORE, MD.—The Maryland Public Service Commission has authorized the Baltimore County Water & Electric Company, of Baltimore, Md., to issue $111,000 in bonds, the proceeds to be used to pay for extensions and improvements to its system. Of this amount $100,000 are to be sold at once and the remaining $11,000 to be held as a sinking fund.

AMHERST, MASS.—Announcement has been made by the Amherst Gas Company of a reduction in the price of electricity for lamps to private consumers from 16 cents to 15 cents per kw-hour and also for street lighting. The rate for incandescent lamps has been reduced from $16 per lamp per year to $15 and for arc lamps from $70 to $66 each per annum.

BEVERLY, MASS.—Contracts have been awarded by the Beverly Gas & Electric Company, of Beverly, for building additions to its plant on River Street, Beverly, to Mack Brothers, of Salem, Mass. The cost of the proposed improvements is estimated at about $200,000.

FALL RIVER, MASS.—Plans are being considered by the Pilgrim Mills, of Fall River, Mass., for the erection of a large spinning mill and weave shop, consisting of 50,000 spindles and 1200 looms. The plant will be equipped for electric motor drive. It is understood that electricity for operating the plant will be secured from the Fall River Electric Light Company.

HUBBARDSTOWN, MASS.—W. A. Belcher, of the Gardner Electric Light Company, of Gardner, Mass., has submitted a proposition to the Selectmen of Hubbardstown, Mass., offering to supply fifty 60-cp incandescent lamps for street lighting at the rate of $20 each per year with midnight service for a period of five years. The town has appropriated $1,000 for street lighting and $100 additional for Williamsville.

MILTON, MASS.—The Selectmen have signed a new contract with the Edison Electric Illuminating Company, of Boston, for a term of ten years beginning with May 1, 1911. The company agrees to supply incandescent lamps at $21.20 each per year with all-night service. Under the new rate the town will save about $900 per year.

NORTH ADAMS, MASS.—The decision handed down by the Board of Gas and Electric Light Commissioners recommends a further reduction in the price of gas and electricity as follows: Beginning with May 1 the net price for electricity furnished by the North Adams Gas Light Company shall not exceed 12½ cents per kw-hour and the minimum charge shall be abolished for both electric and gas service. The price of gas is to be reduced to $1 per 1000 cu. ft. beginning with May 1.

WEBSTER, MASS.—The question of establishing a municipal electric light plant in Webster is under consideration.

WORCESTER, MASS.—The Connecticut River Transmission Company has entered into a contract with the Worcester Pressed Steel Company to supply electrical energy to the amount of 600 hp to operate its plant near Barbers Crossing. The Morgan Spring Company has also placed a contract with the Connecticut company for power to operate its works.

HASTINGS, MICH.—At an election held recently the citizens voted to issue $120,000 in bonds, the proceeds to be used for the construction of a hydroelectric power plant. J. M. Patten is city clerk.

HILLSDALE, MICH.—At an election held recently the citizens voted to appropriate $10,000 for improvements to the municipal electric light plant.

JACKSON, MICH.—The Michigan United Railways Company is reported to be considering the erection of a power plant and substation in Jackson. The power plant, it is said, will have an output of about 6000 kw. M. S. Ralls, of Jackson, is chief engineer.

LUVERNE, MINN.—It is reported that the question of reconstructing the present municipal electric plant or the erection of a new plant is under consideration.

SOUTH HAVEN, MINN.—The South Haven Telephone Company, recently incorporated with a capital stock of $8,000, is preparing to erect about forty-five miles of telephone lines as soon as the weather will permit.

WAYZATA, MINN.—The Village Council has granted the Electric Short Line Railroad Company a franchise to construct and operate its proposed railway through the main streets of the village. Announcement has been made by the company that it proposes to extend the railway to Clara City next year, 120 miles from Minneapolis, Minn. A steam plant to cost $100,000 and shops will be erected by the company in Wayzata. The power plant will supply electricity to operate cars over the thirty miles of tracks, which are to be equipped for electrical operation. The company has applied to the Council for a franchise to supply electricity for lamps and motors and also steam for heating purposes in Wayzata.

CARROLLTON, MO.—The capital stock of the Carrollton Telephone Exchange Company has been increased from $5,000 to $25,000.

MONTGOMERY, MO.—At an election held recently the proposition to grant a twenty-five-year franchise to the Stover Electric Light Company was carried. The company has agreed to improve its service and establish a day service.

MUSSELSHELL, MONT.—Fairbanks, Morse & Company are reported to have been awarded the contract for the installation of an electric light plant in Musselshell.

FULLERTON, NEB.—It is reported that the Fullerton Electric Company is planning to erect a new power house, 32 ft. x 70 ft. New equipment, including two large gas engines and switchboard manufactured by the Western Electric Company, will be installed. The company has also awarded a contract for a 10,000-gal. oil storage tank.

WYMORE, NEB.—The City Council is reported to have adopted plans submitted by C. H. Meeker for an electric power house and city hall combined, bids for construction of which are now being advertised.

MANCHESTER, N. H.—The State Legislature has passed the bill authorizing the city of Manchester to establish and maintain a light and power plant.

NASHUA, N. H.—Announcement has been made by the Nashua Light, Heat & Power Company of a reduction in the price of electricity for lamps from 14 cents to 12 cents per kw-hour and for gas from $1.30 to $1.20 per 1000 cu. ft. The new rate is to take effect from April 1. A reduction is also made in the price of Mazda lamps supplied by the company.

ALBANY, N. Y.—Plans and specifications are being prepared for a standpipe and a complete system of fire protection and rewiring of the entire Capitol Building, involving an expenditure of from $75,000 to $80,000. It is understood that proposals will be called for same. A temporary wiring system is being installed at a cost of about $5,000.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until April 24 for the installation of electric wiring and appurtenances for lamps and motors for the Metropolitan Hospital and surrounding buildings, Blackwell's Island, N. Y., plans for which may be seen at the office of Frank Sutton, consulting engineer, 80 Broadway, New York, N. Y. Michael J. Drummond is Commissioner of Charities.

RIVERHEAD, N. Y.—The Riverhead Electric Light Company has awarded a contract to Overton & Tuthill, of Riverhead, N. Y., to install a new street lighting system in the city. Tungsten lamps will be erected throughout the entire village.

SAVANNAH, N. Y.—The citizens have voted to appropriate $6,300 for the installation of an electric-light plant in Savannah.

WEST POINT, N. Y.—Sealed proposals will be received at the office of the Quartermaster, West Point, N. Y., until May 15 for supplying the United States Military Academy, West Point, with electrical goods, gas and steam fittings and other miscellaneous goods specified in schedules, copies of which can be secured on application to this office, for the fiscal year ending June 30.

DURHAM, N. C.—Plans are being made by the Durham Hosiery Mill No. 1 to erect a building, 115 ft. x 126 ft., to be used for finishing machinery and offices. The mill is operated by electricity.

THOMASVILLE, N. C.—The plant and holdings of the Thomasville Light & Power Company are reported to have been purchased by the Southern Power Company. The Thomasville company supplied electricity for lighting the city and to operate the local street car system. Z. V. Taylor has been elected president of the reorganized company.

DICKINSON, N. D.—Messers. Hughes and Deiters, owners of the local electric light plant, are reported to be contemplating extensive improvements to the electric light system in Dickinson.

FARGO, N. D.—It is reported that the City Council will receive bids for the construction of an electric light plant in connection with the proposed filtration plant.

HANKINSON, N. D.—The Hankinson-Carleton Electric Company, recently incorporated with a capital stock of $25,000, proposes to supply electricity in Hankinson. M. E. Phillips, E. L. Carleton and George F. Phillips, all of Jamestown, are interested in the company.

AKRON, OHIO.—Plans are being considered by the Biggs Boiler Works Company, of Akron, Ohio, to enlarge its plant. The new building is to be 120 ft. x 225 ft. and will be used as a machine shop, an erecting shop and finaging shop and will be equipped for electric motor drive. A power plant will be installed.

AVONDALE, OHIO.—Proposals will be received until May 6 for furnishing material and construction of an electric power plant and lighting fixtures for the Muskingum County Children's Home at Avondale, the equipment to include a motor-generator set and switchboard, including voltage regulator, storage battery and lighting fixtures, erected complete. Plans and specifications may be seen at the office of H. A. Buerhaus, auditor of Muskingum County.

CANTON, OHIO.—The City Council is reported to have authorized an expenditure of $17,000 for electrical equipment for the new auxiliary pumping station in Canton.

CANTON, OHIO.—The American Mine Door Company, of Canton, Ohio, is reported to have decided to enlarge its plant and install a new power plant. N. K. Bowman is general manager.

CINCINNATI, OHIO.—The Union Gas & Electric Company has been awarded the contract to supply electricity for lighting the streets of the city as follows: For arc lamps supplied by overhead circuits at $50 each per year and $55 each per year in the underground district; under the present contract the city pays $60 and $72 each, respectively. The company agrees to install and maintain a boulevard system in the district served by underground wires, bounded by Fourth, Eighth, Central and Main Streets and such other districts as the City Council may designate from time to time at $56 per lamp standard per year. For 80-watt tungsten, mazda or other incandescent lamps in the overhead district, $13 per lamp per year. It is stated that it is proposed to change the gas lamps now in use for electric lamps.

COLUMBUS, OHIO.—The City Council has passed an ordinance authorizing a bond issue of $15,000 to provide funds to extend the municipal electric light system to the annexed territory and for additional lamps in the old sections of the city. Preliminary plans have been completed and work will begin as soon as the bonds are sold.

EAST LIVERPOOL, OHIO.—The Tri-State Railway & Electric Company, recently incorporated, has assumed control, through lease, of all electric railway and light franchises in the East Liverpool district, including the East Liverpool Traction & Light Company, which operates between the Ohio-Pennsylvania State line and the Columbus-Jefferson County line; the Steubenville & East Liverpool Railway & Light Company; the Ohio River Passenger Railway Company, which operates between Pittsburgh, Pa., and Chester, W. Va.; East Liverpool & Chester Bridge Company; electric light franchises and system in East Liverpool and Wellsville, Ohio, together with the power plant and holdings of the Island Coal Company, the mines of which are located over the Pennsylvania State line, and the Ohio River Railroad Company, which operates between Smith's Ferry, Pa., and Beaver, Pa. The company also proposes to take over the Steubenville & Wellsburg Traction Company, of Wellsburg, W. Va., and the Steubenville, Wellsburg & Wierton Railway Company. The properties taken over by the company are valued at more than $3,000,000 and have a bonded debt amounting to $3,000,000, secured by a mortgage.

MIDDLETOWN, OHIO.—The Middletown Gas & Electric Company, controlled by the Sorg estate, has purchased the plant and holdings of the Middletown Electric Lighting Company in this city, and will take possession May 1. It is understood that the consideration was $150,000.

XENIA, OHIO.—Arrangements have been made by the Springfield & Xenia Telephone Company to take over the plant of the Springfield & New Carlisle Telephone Company in case the Legislature enacts a law, under which consolidations can be made. The plan proposed is for the local companies to handle the local business, while the Bell companies, which control the New Carlisle Company, will take over the long-distance business.

HELENA, OKLA.—At an election held recently the citizens are reported to have voted in favor of the proposition to issue bonds to the amount of $10,000, the proceeds to be used for the installation of an electric light plant in Helena, Okla.

KINGFISHER, OKLA.—Bonds to the amount of $28,000 have been voted, the proceeds to be used for extensions to the water-works system and enlarging the electric light plant. The system will be changed from single-phase to three-phase. V. H. Francis is superintendent of water and light plant.

OKEMAH, OKLA.—W. H. Dill is reported to be contemplating the construction of a hollow concrete dam, to cost from $40.000 to $50,000. The proposed dam will be located about 7 miles from Okemah; the power will be utilized to generate electricity for transmission.

BROWNSVILLE, ORE.—Negotiations have been closed whereby the Oregon Power Company has secured the property of the Brownsville Electric Light Company. Electricity for operating the local system will be supplied from the plant at Springfield and later from the large hydroelectric plant on the McKenzie River, now under construction. The high-tension transmission line will be extended from Halsey to Brownsville. It is proposed to rebuild the local system and establish a day service for both lamps and motors. The system was taken over by the new owner April 1.

PORTLAND, ORE.—The Mount Hood Railway & Light Company has purchased the power plant of the Monarch Lumber Company. The Monarch plant will be used in connection with the new power plant of the Mount Hood company, now under construction on the peninsula to supply electricity for lamps and motors in Portland and vicinity until the large hydroelectric plant at the junction of the Bull Run and Sandy Rivers is completed.

CHESTER, PA.—The Beacon Light Company is reported to be preparing plans for extensive improvements to its system. The installation of a large coal-conveying plant, it is understood, is among the improvements contemplated.

ERIE, PA.—The Erie & Suburban Railway Company has applied for a charter to build an electric railway between Millcreek and Harborcreek. The incorporators are: J. M. Sherwin, W. F. Burgess, Dorman Weaver, H. Schuwerk and Frank Brown.

ERIE, PA.—The Erie Light Company has applied for a charter for the purpose of supplying electricity for lamps and motors in Erie. The new company, it is said, will secure electricity from the transmission line of the Niagara Falls Power Company, which has been extended as far as Westfield, N. Y.

HARRISBURG, PA.—The Central Pennsylvania Traction Company is contemplating the purchase of new engines and generators with a rating of from 1000 kw to 1500 kw for its power plant in Harrisburg during the next six weeks. Frank B. Musser, of Harrisburg, is president and general manager.

HUMBERT, PA.—The United Railways Company, recently granted

charter, is planning to build an electric railway to connect Humbert and Barronsvale, 7 miles long. The company is capitalized at $70,000. The incorporators are: I. W. Seamans, of Uniontown, Pa., president; T. B. Palmer, B. A. Smith, L. W. Fogg, J. H. Palmer, D. D. Johnson and Harold W. Seaman, of Uniontown.

WOONSOCKET, R. I.—Plans are being prepared by the Stone & Webster Engineering Corporation, of Boston, Mass., for the construction of a concrete dam in Woonsocket to replace a wooden dam.

ORANGEBURG, S. C.—Plans are being considered to enlarge the municipal electric-light plant in order to meet the increased demands made upon it. New equipment, including engines and generators, will be installed.

WAGNER, S. D.—The Interstate Power Company, of Oshkosh, Wis., is reported to have purchased the plants and property owned by the Dakota Gas, Electric Light & Power Company at Platte, Geddes, Lake Andes, Wagner, Armour and Scotland. It is said that the consideration for the Charles Mix County plants, not including the systems at Armour and Scotland, was $145,672.

GALLATIN, TENN.—Sealed bids will be received by the city of Gallatin until May 5 for furnishing one Corliss engine, two 100-kw, alternating-current, three-phase engine-type generators, two marble switchboards and two electrically operated pumps, either plunger or multistage centrifugal type, having a capacity of 500 gal. per minute. Plans and specifications are on file at the office of the clerk of the Water and Light Commission. E. L. Anderson is chairman of the Water and Light Commission.

KINGSLAND, TEX.—Arrangements are being made by C. H. Alexander, of Dallas, Tex., who is at the head of the Colorado River Power Company, which is constructing a large hydroelectric plant at Marble Falls, Tex., for the construction of a large dam and hydroelectric plant near Kingsland. The proposed plant will develop about 10,000 hp and will be operated in connection with the Marble Falls plant. The two plants will supply electricity to towns and cities within a radius of 150 miles.

LLANO, TEX.—Plans are being considered for extensions and improvements to the municipal electric light plant in Llano.

MARSHALL, TEX.—The Marshall Traction Company is contemplating building an extension to its street railway system, one and one-half miles in length, and other improvements.

SAN ANGELO, TEX.—J. D. Sugg, of San Angelo, who recently purchased the local electric street railway system, is planning to make extensive improvements to the property, including the construction of new lines.

TULIA, TEX.—It is reported that bonds to the amount of $25,000 have been voted, the proceeds to be used for the construction of an elcetric light plant and water-works system in Tulia.

KAMAS, UTAH.—Plans are being made by the Kamas Valley Development Company to begin work on development of its water rights, for which surveys have been completed. R. W. Barnes is interested in the company.

FAIR HAVEN, VT.—Arrangements have been made by the Rutland Railway, Light & Power Company to equip the slate mill of Durick & Keenan, of Fairhaven, for electrical operation. The Rutland company has secured a contract to supply electricity to the Bomoseen Slate Company for its quarry at Cedar Mountain. Preparations are being made to erect a transmission line to the quarry, to be completed in about thirty days.

CLARENDON, VA.—The Clarendon Electric Company, recently incorporated with a capital stock of $200,000, it is reported, is planning to erect transmission lines and substations for the distribution of electricity for lamps, heat and motors in Alexandria and Fairfax Counties, Virginia. It is understood that the company proposes to purchase electrical energy to operate its system. M. E. Church, of Falls Church, Va., is president; L. L. Northrup, secretary, and E. Wiley Stearns, treasurer, both of Clarendon, Va.

FT. MONROE, VA.—Sealed bids will be received at the office of the post quartermaster, Ft. Monroe, Va., until April 25 for furnishing 134 holophane shades, 61 pendent switches, 22 rosettes, 67 fixture blocks, 158 shade holders, 144 pendent sockets, 2400 ft. rubber-covered wire, 1200 ft. molding, 600 ft. lamp cord, 67 snap switches and 6 fixtures 6 ft. long. Captain R. B. McBridge is post quartermaster.

IVANHOE, VA.—The Carter Iron Company, Park Building, Pittsburgh, Pa., is reported to be making preparations for the construction of a hydroelectric power plant to develop 3300 hp. Electricity generated at the plant will be used to operate iron furnaces, for mining, railway and lighting purposes.

NEWPORT NEWS, VA.—It is understood that the City Council will submit the proposition to issue $150,000 in bonds for the construction of a municipal electric light plant to a vote of the people.

PORTSMOUTH, VA.—The Seaboard Air Line Railway Company has recently placed orders for additional telephone train dispatching equipment covering more than 600 miles, with two complete circuits.

CHEHALIS, WASH.—The new factory now under construction by the Palmer Lumber & Manufacturing Company in Chehalis, it is said, will be equipped for electric motor drive.

OLYMPIA, WASH.—Preparations are being made by the Olympia Light & Water Company for the construction of the Lawrence Lake Reservoir to supply supplementary water to the Deschutes River during the low-water periods for operating its system. Hazard Stevens, of Boston, Mass., is president.

LOGAN, W. VA.—The Aracoma Coal Company, of Logan, W. Va., has awarded a contract to the W. E. Wolfenden Electrical Company, of Roanoke, Va., for the construction of its light and power plant.

OAK HILL, W. VA.—The Beckley & Fayetteville Telephone Company is reported to have increased its capital stock from $5,000 to $25,000.

GRAFTON, WIS.—The Jungers Stove & Range Company, of Grafton, Wis., is reported to be preparing to erect a plant for the manufacture of stoves and ranges. The plant will be equipped for electric motor drive.

MARINETTE, WIS.—The City Councils of Marinette, Wis., and Menominee, Mich., have adopted resolutions providing for the introduction of bills in the Legislatures of Wisconsin and Michigan and Congress to prohibit power generated at the hydroelectic power plant to be erected on the Menominee River to be carried out of the two counties. The proposed plant will have an output of 50,000 hp, a large part of which will be utilized in the cities of Marinette and Menominee.

NEW LISBON, WIS.—The City Council has engaged Langstead & Myers, of Appleton, Wis., engineers, to take charge of the construction of the municipal electric-light plant and water-works system. The cost of the work is estimated at $20,000.

LETHBRIDGE, ALTA, CAN.—Owing to the large profit in the operation of the municipal electric-light plant last year the City Council has reduced the rates for electricity for lamps and motors 25 per cent. During the past year a net profit of $30,000 is shown by the plant.

REVELSTOKE, B. C., CAN.—Plans are being considered for the construction of a power plant on the Columbia River near Revelstoke and also the erection of a paper and pulp mill. F. C. Adams, of Portland, Ore.; C. D. Danahar, of Tacoma, Wash., and Charles A. Barnum are reported to be interested in the project.

VANCOUVER, B. C., CAN.—The British-Canadian Lumber Company is planning to erect a large lumber mill on Lulu Island, near New Westminster, this summer, which will have a cutting capacity of 250,000 ft. per ten hours. The plant will be equipped for electric motor drive.

WINNIPEG, MAN., CAN.—Preparations are being made for large extensions to the Manitoba government telephone system which will involve an expenditure of about $750,000. F. C. Patterson is chairman.

COBALT, ONT., CAN.—Preparations are being made by the Cobalt Power Company to install a water-works system and electric plant to supply electricity for street and commercial lighting in South Porcupine. The plant will be located on Bloor Avenue. The plant will be operated by steam power until the transmission line is extended from Sandy Falls plant, now under construction by the company. It is expected to have the system ready for operation by June 1.

LINDSAY, ONT., CAN.—The Hydroelectic Power Commission is reported to have secured an option on the plant of the Lindsay Light, Heat & Power Company for the town of Lindsay, and in addition has been furnished reports of the company's hydroelectric plant at Fenelon Falls, with an output of 2000 hp, which is transmitted to Lindsay. The ratepayers have authorized the town to open negotiations with the company and it is expected that an offer will be male to the company on the basis of the price named in the option.

LONDON, ONT., CAN.—It is reported that negotiations are under way by a syndicate headed by Murray A. Verner, of Pittsburgh, Pa., for the consolidation of the London Electric Light Company, the London Street Railway Company and the Southwestern Traction Company (now the London & Lake Erie Transportation Company).

PETERBORO, ONT., CAN.—The Hydroelectric Power Commission has secured an option of the Otonabee Power Company's hydroelectric plant and transmission system, now supplying 3000 hp from locks No. 4 and 5 on the Trent Canal. In presenting the option to the citizens' committee at Peterboro, Adam Beck, chairman of the commission, stated that by carrying out the proposition the city would be able to secure a twenty-four-hour service at from $16 to $17 per horsepower per year, and by taking up the option would have an immediate service free of competition.

RIPLEY, ONT., CAN.—Tenders will be received by Angus Martyn, secretary and treasurer, Ripley, Ont., Can., until May 11, for construction of a telephone system in the township of Kinloss, Ont., plans and specifications for which may be seen at the office of Angus Martyn, secretary and treasurer.

SANDWICH, ONT., CAN.—The town of Sandwich has granted Robert Stuart a franchise to erect transmission lines through Sandwich. Mr. Stuart is planning to install a large electric plant in Sandwich on the old Mineral Springs property to supply electricity in the towns of Essex, Leamington and Kingsville, and also proposes to furnish electrical service to farmers along the route of the transmission line.

TORONTO, ONT., CAN.—Sealed bids will be received by G. R. Geary, Mayor, chairman of Board of Control, City Hall, Toronto, Ont., Can., until June 6 for vertical electrically driven pumps, motors and other electrical equipment, screens and cleaning apparatus and venturi meters for the main drainage works. Specifications and form of tender may be obtained at the office of the city engineer, Toronto.

TORONTO, ONT., CAN.—Arrangements have been completed by the Temiskaming & Northern Ontario Railway Commission for the purchase of the Nipissing Central Railway, an electric railway extending

from Cobalt to Haileyburg, in the Cobalt region. The purchase includes the control of the water power at High Falls. It is expected that the government will now carry out plans for the ultimate equipment of the entire system of the Temiskaming & Northern Ontario Railway system for electrical operation.

HULL, QUE., CAN.—The Hull Electric Railway Company is reported to be contemplating extending its railway to Chelsea, work on which will begin in the near future.

REGINA, SASK., CAN.—Bids will be received until April 25 by S. S. Porter, Deputy Minister of Railways, Telephones and Telegraphs, for the construction of four long-distance telephone lines for the provincial system. Tenders will soon be called for erection of other lines.

BALSAS, GUERRERO, MEX.—Surveys are being made for the proposed hydroelectric plant to be erected on the Balsas River, near Balsas, by the Balsas Power & Irrigation Company. The proposed plant will develop about 40,000 hp, and will supply electricity for mining districts, towns and industrial plants within a radius of 65 miles. The company will also install a large irrigation system in connection with its power project. The proposed dam will be approximately 165 ft. high and 570 ft. long and will cost about $1,000,000. A B. Adams, inc., of Mexico City, is interested in the enterprise.

MATAMOROS, MEX.—A concession has been granted by the State government of Tamaulpas and the municipal government of Matamoros to A. B. Cole, R. B. Renfro and R. C. Cowen, all of Brownsville, Tex., and Procofio Guerra, of Matamoros, for the construction of an electric railway from the Mexico terminus of the new international bridge across the Rio Grande River to the city of Matamoros, about three miles in length, and over the principal streets in this city. It is reported that the same parties are contemplating the construction of an electric railway system in Brownsville, Tex., and extending the railway across the bridge to connect with the Mexico system.

New Industrial Companies.

THE ACCUMULATOR LIGHTING COMPANY, of Winnipeg, Man., Can., has been incorporated with a capital stock of $50,000 by A. R. Sutherland, agent; T. Froggatt, manager, and J. D. Suffield, all of Winnipeg.

THE ACME ELECTRIC APPLIANCE COMPANY, of Brantford, Ont., Can., has been incorporated with a capital stock of $300,000 by G. Brereton, O. M. Mackie, of Hamilton; A. Sheard, of Brantford, and N. G. Patterson, of Cambridge, Ohio.

THE CONSOLIDATED ELECTRIC SIGN COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing and dealing in electric signs and equipment therefor. The incorporators are: P. L. Becker, F. E. Parks and William E. Mooney.

THE EDWARD SPRANGLEY ELECTRIC COMPANY, of New Orleans, La., has been incorporated with a capital stock of $25,000 to manufacture electrical appliances. Edward Sprangley is president of the company; S. B. Swift, secretary and manager, and A. W. Lewin, treasurer.

THE GRISSINGER TELEPHONE REPEATER COMPANY, of Buffalo, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing and dealing in telephone apparatus. The incorporators are: E. Grissinger, L. A. Grissinger and C. F. Wheeler, of Buffalo, N. Y.

THE HARBROOK ELECTRIC & MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by A. T. Holbrook, of Summit, N. J. I. Josephson and J. T. Sullivan, of New York, N. Y. The company proposes to manufacture electrical and mechanical appliances.

THE JEFFRIES ELECTRIC & MANUFACTURING COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000 by S. S. Jeffries, O. L. Jeffries, H. H. Culbertson and others.

THE NATIONAL ELECTRIC COMPANY, of Boston, Mass., has been incorporated with a capital stock of $50,000, to manufacture electrical supplies. C. H. Sprague, of Newton, Mass., is president and treasurer.

THE SUPERIOR FIXTURE COMPANY, of Des Moines, Ia., has been organized to manufacture gas and electric lighting fixtures. John C. Hansen and F. M. Deemer are interested in the company.

New Incorporations.

OAKLAND, CAL.—The American Heat & Power Company has been chartered with a capital stock of $100,000 by J. H. King, A. Craig, of Oakland, Cal., and J. H. Becker, of San Francisco, Cal.

OKLAHOMA CITY, OKLA.—The Monticello Company has been incorporated by Thomas P. Smith, L. E. Haskell and Thomas P. Smith, all of Muskogee. The company is capitalized at $100,000 and proposes to supply electricity for lamps and motors and water power.

JOHNSTOWN, PA.—The Bens Creek Light, Heat & Power Company has filed articles of incorporation with a capital stock of $5,000. The directors are: C. G. Campbell, 445 Somerset Street, Johnstown, Pa., treasurer; John H. Waters, of Johnstown, Pa., and H. H. Weaver, of Westmount, Pa.

JOHNSTOWN, PA.—Articles of incorporation have been filed with the Secretary of State for the Cambria Light, Heat & Power Company, the Stonycreek Light, Heat & Power Company and the Upper Yoder Light, Heat & Power Company. Each company is capitalized at $5,000 and the directors are: C. G. Campbell, 445 Somerset Street, Johnstown, Pa., treasurer; H. H. Weaver, of Westmount, Pa., and John H. Waters, of Johnstown, Pa.

ALBERNI, B. C., CAN.—Articles of incorporation have been filed for the Alberni District Electric Light & Power Company for the purpose of supplying electricity in Alberni. Dr. A. D. Morgan is president and W. W. G. McAllister is secretary and treasurer.

COBALT, ONT., CAN.—The Northern Ontario Light & Power Company has been incorporated with a capital stock of $7,500,000. It is understood that the company proposes to take over the light and power systems in Cobalt and Haileybury and the hydraulic system which supplies power to the mines in this district. David Fasken is reported to be interested in the company.

OTTAWA, ONT., CAN.—The Development Company of Canada has been incorporated with a capital stock of $1,000,000 for the purpose of developing a large power project on Rapids du Quinze. It is estimated that 150,000 hp can be developed, which will be distributed in the Cobalt region. For further information address M. J. O'Brien, of Renfrew, Ont., Can.

Personal.

MR. ARTHUR S. PARTRIDGE, a well-known electrical man of St. Louis, Mo., has been appointed a member of the board of education of that city.

MR. SAMUEL G. McMEEN, who has spent the last four years in San Francisco designing, constructing and developing a number of telephone properties, will return to his home in Chicago about May 1.

MR. HORACE G. BURT, formerly president of the Union Pacific Railroad, has been chosen chief engineer by the commission appointed to investigate the problems involved in the Chicago terminal electrification.

PROF. ARTHUR F. NESBIT, of the Department of Physics of the New Hampshire State College, addressed the Worcester Polytechnic Institute Branch of the A. I. E. E., on the subject of the induction motor on April 14.

MR. LEONARD KEBLER, president of the Ward Leonard Electric Company, delivered an illustrated address entitled "Electric Devices on Gasoline-Driven Vehicles" before the Brooklyn Institute of Arts and Sciences on March 14.

MR. RODMAN GILDER has resigned as secretary of the Crocker-Wheeler Company to become associated with the brokerage house of Dick Brothers & Company, New York, which handles bonds of many industrial and similar corporations.

DR. A. E. KENNELLY has accepted an invitation from the University of London to deliver a short series of lectures in London, at the end of May next, on "The Application of Hyperbolic Functions to Electrical Engineering Problems."

DR. C. P. STEINMETZ addressed the members of the Baltimore Section of the American Institute of Electrical Engineers in the physical laboratory of Johns Hopkins University last week on "New Developments in Electrical Engineering Theory."

DR. JOSEPH W. RICHARDS, professor on metallurgy at Lehigh University, addressed the Engineers' Society of Western Pennsylvania, in Pittsburgh, on April 18, his subject being "The Electrometallurgical Revolution in the Iron and Steel Industry of Norway and Sweden."

MR. J. H. PALLISTER, chief engineer of the power station of the Lincoln (Neb.) Traction Company, has been promoted to the position of electrical engineer of the company, filling the post relinquished by Mr. N. A. Kemmish, who resigned to become general manager of the municipal electric lighting and pumping station at Alliance, Neb., as noted in these columns April 6.

MR. CONVERSE D. MARSH, president of the Bates Advertising Company, well known among electrical engineers for the active part taken by him in the development of the high-efficiency carbon lamp during his identification with the Bryan-Marsh Company, received a fracture of the right leg on April 16 as a result of being knocked down by an automobile in Fifth Avenue, New York.

MR. W. H. OLIN, industrial commissioner of the Denver, Laramie & Northwestern Railway, was the speaker at the mid-week lunch of the Colorado Electric Club in Denver, on April 13, the subject being "Our Bill-of-Fare." He emphasized the necessity for better farming methods and for better transportation facilities in order to minimize the cost of food supply and he spoke of the economic values of electric applications on farms.

MR. MORRISON R. LASH has been appointed electrical engineer of the Union Electric Company, Dubuque, Ia., succeeding Mr. W. N. Keiser, who has resigned to join the staff of the G. M. Parsons Company, Newton, Ia. Mr. Lash is a graduate of the Rose Polytechnic Institute, and was engaged for several years in the electrical contracting business in Indianapolis, Ind. For the past ten years he was in the employ of the Western Electric Company.

MR. WILLIAM S. KENYON, who, as assistant to the Attorney General of the United States, was largely instrumental in preparing the government case against the incandescent-lamp manufacturers, was elected United States Senator from Iowa on April 12. Mr. Kenyon's home is in Ft. Dodge, Ia., and he has been assistant to the Attorney General for about a year. In that capacity he has been particularly active in preparing for the government suits brought under the Sherman anti-trust law.

DR. SVANTE ARRHENIUS, president of the Nobel Physical Institute in Stockholm, Sweden, is at present on a lecturing tour in this country under the auspices of the Lowell Institution in Boston. During the past week Dr. Arrhenius has been in New York as the guest of Dr. Jaques Loeb of the Rockefeller Institute. On Wednesday, the 12th instant, Dr. Arrhenius was the guest of honor at a dinner given by the Captain John Ericsson Memorial Society of Swedish Engineers at the Engineers' Club. Before returning to Sweden Dr. Arrhenius will deliver some public lectures at Columbia University and possibly one before an engineering society. In 1884 Dr. Arrhenius attained the degree of doctor of physics and has since been among the foremost of scientists. In 1887 he published his theory of electrolytic dissociation, which probably is the most important of his many achievements, and during the following ten years he wrote a great many papers on this subject. In connection with his early studies of the conductivity of solutions he had investigated electric conduction in silver chloride in light and darkness, in phosphorescent and illuminated air, and in Bunsen flames in which various salts were vaporized. In 1888 he studied the influence of the sun's rays on the electrical state of the atmosphere. From 1895 to 1898 he published researches on the moon's influence on auroras, thunderstorms and terrestrial electricity, the twenty-six-day period of thunderstorms and auroras, and the effect produced on the earth's temperature by the carbon dioxide of the atmosphere. In 1898 he published a paper on the effect of cosmical influences upon physiological conditions. In 1905 he produced a two-volume textbook on cosmical physics, containing many original ideas relating to the origin of the heavenly bodies. Later he published "Worlds in the Making." Recently Dr. Arrhenius has taken up the study of serum-therapy.

Obituary.

MR. ROBERT WEBB MORGAN, president and director of the Ætna Electric Company and of the Anchor Lamp Company, died of pneumonia on April 17 at his home in Bronxville, N. Y.

MR. EUGENE W. SULLIVAN, secretary of the Cosmopolitan Electric Company, of Chicago, and brother of Mr. Roger C. Sullivan, president of the company, died on April 14. Mr. Sullivan did not take an active part in the affairs of the company. He was, however, active in politics, in which his brother is even more conspicuous. He was born in Belvidere, Ill., in 1865, and leaves a wife, but no children.

Trade Publications.

CIRCUIT BREAKERS.—The Cutter Company, Philadelphia, is distributing advertising blotters calling attention to its circuit breakers in a striking manner by the use of brief quotations from well-known sources which are neatly turned to point to the I-T-E breakers.

TACHOMETERS.—Tachometers for testing and recording the revolution and speed of shaftings, machines, engines, etc., are described in Bulletin No. 146 of the Bristol Company, Waterbury, Conn. These tachometers are especially valuable in connection with electric generators, etc.

REFLECTOR SOCKETS.—The Benjamin Electric Manufacturing Company, of Chicago, has issued Bulletin No. 7, in which are listed and described reflector sockets which can be properly adjusted in order to obtain the most satisfactory illumination results from incandescent lamp installations.

SYSTEM OF LIGHTING.—Catalog No. 407, issued by the H. W. Johns-Manville Company, New York, is devoted to its J-M linolite system of lighting. The linolite lamp comprises a tube nearly 1 ft. long, having a uniform diameter of 1 in. In place of the cap or base at one end, it has caps at both ends, and instead of the circuit passing through and out at the same end it is made at one end and passes out through the other. The filament is not looped as in the ordinary incandescent lamp, but stretched the entire length of the tube. The lamp is one of the elements of the system, which in its entirety includes the lamp, sockets, reflectors, conduit and means of support. These are combined according to requirements of the various uses to which the system is adapted. The lamp is made with tungsten or other filaments, and is used for store window lighting, showcase lighting, shelf lighting, picture lighting, etc., and can also be obtained in desk and portable forms.

BUSINESS NOTES.

WILLIAM RYLE & CO., manufacturers of silk for insulating purposes, have moved from 54 Howard Street to 225 Fourth Avenue, New York.

THE VICTOR ELECTRIC COMPANY has moved its main office and factory from 55 Market Street to the corner of Jackson Boulevard and Robey Street, Chicago.

THE ALLIS-CHALMERS COMPANY has moved its Chicago sales offices from the First National Bank Building to the People's Gas Building, Michigan Boulevard and Adams Street.

ADAMS-BAGNALL COMPANY.—Owing to the new system of street nomenclature in Chicago, the Chicago office of the Adams-Bagnall Electric Company, of which J. G. Pomeroy is Western sales manager, is now at 217 South Dearborn Street.

THE CENTRAL STATION DEVELOPMENT COMPANY.—Mr. Leonard J. Bolting has resigned as secretary and general manager of the Central Station Development Company to carry on the work as an individual rather than a company.

FERRIS ELECTRIC COMPANY.—The firm of Ferris & Salisbury having been dissolved, Mr. Charles R. Ferris has formed the C. R. Ferris Electric Company, with headquarters in the Case-Meade Building, Providence, R. I., for conducting the business of electrical contracting, construction and repair work.

AMERICAN CARBON & BATTERY COMPANY.—The American Carbon & Battery Company has removed its executive offices to the La Salle Building, St. Louis, Mo. All correspondence should now be addressed to the company at 509 Olive Street, St. Louis, Mo., rather than to the factory in East St. Louis, Ill.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Philadelphia, has recently adopted the catch phrase "The Complete Arrester," as applying to the Garton-Daniels lightning arrester. The construction of the Garton-Daniels lightning arrester is such that it has the three essential features—a small air gap, low series resistance and a circuit-breaker—in combination in one unit, thereby making it complete in itself.

SPRANLEY ELECTRIC COMPANY.—After having been connected with the New Orleans office of the Sprague Electric Company since its opening about five years ago, Mr. A. W. Lewin has resigned his position as manager to become associated with the Ed. Spranley Electric Company as treasurer and manager of the sales department. This company will conduct a strictly jobbing business in the electrical supply line.

INTERNATIONAL ACHESON GRAPHITE COMPANY.—Through an agreement entered into between the International Acheson Graphite Company and the Acheson Oildag Company, the first-named company on April 1 became general agent in the United States for the sale of the new lubricants, oildag and aquadag, products of the second-named company. All Acheson graphite is made in the electric furnace, while all other graphite is mined from the earth. The production of Acheson graphite last year was over 13,000,000 lb., which is said to be far more than all the graphite mined in the United States during the same period.

THE HOOPER-FALKENAU ENGINEERING COMPANY has recently been formed to take over the business of Mr. George K. Hooper, whose experience covers a period of twenty-five years of work ranging in importance from that of an unskilled laborer to executive and consulting engineer. Mr. Hooper's recent work has included the designing and planning of a wide variety of industrial projects. Mr. Falkenau, in joining forces with Mr. Hooper, withdraws from the Falkenau-Sinclair Machine Company, of Philadelphia, of which he has been president for a number of years. His best known work is in the field of designing and manufacturing special machinery. In the course of thirty years' experience as a consulting engineer and owner of machine works Mr. Falkenau has designed many successful devices, among which probably the best known is the pneumatic system for handling mail. The new firm will carry on the same class of work that each member has done previously.

BROOKFIELD GLASS COMPANY DINNER.—A testimonial dinner was tendered to Mr. B. M. Downs, president of the Electrical Manufacturers' Club, at the Union League Club, New York, Friday evening, April 14, by the Brookfield Glass Company, of which company Mr. Downs is vice-president. The dinner was to celebrate the twenty-fifth anniversary of Mr. Downs' connection with the Brookfield Company, and was attended by about twenty of his business friends in the electrical field, among whom were the following: Messrs. T. M. Debevoise, lawyer; Frank Brookfield, secretary and treasurer Brookfield Glass Company; R. G. Hemingray, president Hemingray Glass Company; R. E. Gallagher, secretary New York Insulated Wire Company; W. L. Fort, Western Electric Company; *Electrical World;* R. B. Corey, president R. B. Corey Company; E. W. Rockefellow, supply sales manager Western Electric Company; J. B. Olson, secretary Habirshaw Wire Company; F. F. Downs, treasurer and manager United States Can Company, Cincinnati; W. Joerger, General Chemical Company; W. S. Benedict, Benedict & Benedict, Brooklyn; Herbert Sinclair, Star Porcelain Company, Trenton; T. L. Cuyler, assistant treasurer Postal Telegraph Cable; Clarence Winter, lawyer; C. C. Hay, Ingersoll-Rand Company; A. H. Pease, president Hart & Hegeman Company; A. T. Clark, secretary American Circular Loom Company; Walter Cary, manager Westinghouse Lamp Company; C. W. Price, *Electrical Review;* B. M. Downs, vice-president Brookfield Glass Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 11, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

989,008. CIRCUIT TROUBLE INDICATOR; C. L. Healy, Chatham, N. J. App. filed Oct. 12, 1910. For printing telegraph circuits with two normally balanced co-operating partial circuits, printing instruments having parts in each circuit and an electric indicator coacting with the partial circuits for indicating a lack of balance between them.

989,018. ALTERNATING-CURRENT MAGNET; N. O. Lindstrom, Nutley, N. J. App. filed Oct. 27, 1910. Prevents chattering by so arranging the armature and so laminating the poles that the magnetic field continues by reason of eddy currents while the current fluctuates, thus preventing a dropping away of the armature.

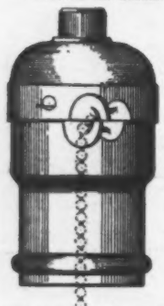
989,030. GOVERNOR FOR GAS ENGINES; P. Okey, Columbus, Ohio. App. filed Feb. 16, 1910. Electromagnetic valve mechanism for controlling the feed of the gas to the generator, one valve controlled by variations in current strength of the dynamo driven by the engine and the other by variations in voltage.

989,063. SYSTEM OF MOTOR CONTROL; G. B. Schley, Milwaukee, Wis. App. filed July 3, 1909. For rolling mills and hoisting machinery with separately excited motor, a control for varying the voltage upon the armature, the current in the motor armature actuating means for preventing the controller from raising the armature current above a predetermined value, but allowing the controller to diminish the impressed voltage when such diminution would decrease the current in the motor armature circuit.

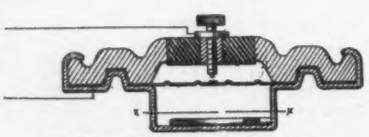
989,076. MOUTHPIECE; L. Steinberger, New York, N. Y. App. filed June 13, 1910. The mouthpiece has an annular groove with a plurality of passages extending through the body and cone-shaped, the cones being oppositely arranged, and opening toward the diaphragm.

989,107. FIRE ALARM; J. E. Barrett, Pollock, La. App. filed April 30, 1910. Fire-alarm bell signal with fusible conducting wires between a magnet and the source of electric supply, the magnet holding the bell armature from ringing, but allowing it to be operated by the bell magnet when the wires fuse.

989,127. HOVER FOR POULTRY; G. M. Curtis, Buffalo, N. Y. App. filed Aug. 28, 1908. For growing chicks. A flat resistance coil is suspended horizontally from the top of the hover and carries a thermostat in series with the coil to control the temperature.



989,220.—Chain Guide for Electrical Pull Sockets.



989,347.—Electrical Thermostat.

989,133. SELECTOR MECHANISM; A. F. Dixon, New York, N. Y. App. filed Jan. 20, 1908. For automatic or semi-automatic telephone exchange system for operating the brush carrier, which is moved step by step and returns to initial position by a single movement. The brush, instead of being actuated directly by magnets, is actuated by power from another source, the selecting magnets throwing in stops to limit the movement of the brush.

989,148. CARBON HOLDER FOR ELECTRIC FURNACES; P. L. T. Heroult, La Praz, France. App. filed Sept. 7, 1910. A metal clamp embracing the carbon with means for cooling it and slitted to dissipate the heat.

989,169. ELECTROMETALLURGICAL FURNACE; F. Louvrier, Mexico, Mexico. App. filed Dec. 18, 1909. A furnace divided into reduction and condensing chambers, the volatile member being delivered from the reducing to the condensing chamber, with means for feeding the ore to the reducing chamber for heating the ore to volatilize it and for cooling it, the heating means being electrical.

989,191. MULTIPLE TELEPHONE RECEIVER; W. B. Relth, Chicago, Ill. App. filed Aug. 14, 1905. For connecting in a plurality of telephone receivers to enable a number to hear a conversation. Makes use of spring contacts connected to the receiver wires which can be slipped over the terminals of a receiver.

989,194. SIGNAL SYSTEM FOR RAILWAYS; A. L. Ruthven, Topeka, Kan. App. filed Feb. 20, 1909. Third-rail and locomotive, the latter carrying a partial circuit which is completed thorugh the third-rail to give a signal.

989,205. TELEPHONE SYSTEM; D. L. Temple, Chicago, Ill., and C. L. Goodrum, Atlantic City, N. J. App. filed March 1, 1902. A telephone line with relay for supervising which controls a lamp.

989,212. AERIAL CONDUIT AND CABLE GUARD; E. M. Van Nostran, Wabash, Ind. App. filed Jan. 10, 1910. A messenger wire, an electric cable supported on the wire by hangers and a continuous inclosing tubular guard offsetting from contact with the cable with an air space between.

989,220. CHAIN GUIDE FOR ELECTRICAL PULL SOCKETS; D. P. Wolhaupter, Washington, D. C. App. filed Jan. 5, 1911. The guide body opens laterally to admit the laying in and removal of the pull chain, the sections being carried by the separate members of the socket shell.

989,231. INSULATOR SUPPORT; W. L. Chamberlain, East Hartford, Conn. App. filed June 5, 1908. A base for supporting insulators at various angles with rotatable supports for the insulators.

989,259. VAPOR ELECTRIC APPARATUS; P. C. Hewitt, New York, N. Y. App. filed Feb. 20, 1902. An exhausted container containing a plurality of anodes, a vaporizable reconstructing cathode, all supplied by polyphase alternating current with an inductance in the lead from the cathode and starting means for temporarily passing starting current through the inductance and around the rectifier.

989,273. THERMOSTATIC CONTROL FOR ELECTRIC HEATING DEVICES; E. C. McBride, Santa Ana, Cal. App. filed July 26 1909. An electric laundry iron with a cut-out controlled by a thermostat for cutting off the current when the iron becomes unduly heated and for re-establishing the current when at normal temperature.

989,292. ELECTRIC ARC LAMP; W. R. Ridings, Stratford, England. App. filed Dec. 28, 1905. Brings the arcing points of the electrode together for starting the arc, the electrodes being inclined downwardly and toward each other. Provides a horizontal strip of insulation on which the electrodes rest when the lamp is not in operation, a slotted plate through which they project, a movable strip with hole through which an electrode passes and a bell crank lever connected to the clutch and attached to the movable strip.

989,305. ELECTRIC SYSTEM OF DISTRIBUTION; W. H. Sherbondy, Fort Wayne, Ind. App. filed Nov. 3, 1910. For lighting railway cars, using a storage battery, a plurality of work circuits, a voltage regulator, which latter is disconnected when the work circuits are disconnected and thrown in when the work circuits are thrown in.

989,335. SIGNAL FOR FIRE SPRINKLER SYSTEMS AND THE LIKE; L. D. Chandler, North Abington, Mass. App. filed March 4, 1910. A signal is sounded after a given quantity of water has passed through the apparatus, but which is not operated on leakage of water.

989,347. ELECTRIC THERMOSTAT; Albert Goldstein, New York, N. Y. App. filed May 2, 1910. A spiral tube is arranged within the thermostat chamber which retards the escape of air so that a gradual change of temperature will not start the current flowing, but a quick change will do so.

989,362. KNIFE SWITCH; O. H. Hoeft, Brownlee, Neb. App. filed May 24, 1910. Single or double pole switch of the handle and knife type for rounding or testing lines in case of trouble. Details of construction.

989,364. SWITCH; C. Huffman, Versailles, Mo. App. filed July 23, 1910. Knife switch forming a lightning arrester when thrown to inoperative position.

989,401. CONTROLLER FOR ELECTRIC MOTORS; W. A. Paris, Edgewood Park, Pa. App. filed Dec. 28, 1905. Motor for driving pumps, started and stopped in accordance with the predetermined fluid head by means of a reservoir, a motor controller with ratchet wheel, pawls and cam, controlled by the height of fluid in the reservoir.

989,414. ELECTRIC TANK SWITCH; H. A. Prindle, East Orange, N. J. App. filed Oct. 14, 1908. Electric tank switch controlled by the rise and fall of water in tanks which makes and breaks a circuit and starts and stops an electric motor and pump driven thereby. The switch is adjustable for different water levels.

989,420. FIRE ALARM; L. T. Reichel, Wellington, New Zealand. App. filed Dec. 22, 1908. A thermopile with galvometer in circuit, a terminal near the galvometer pointer, a magnet near the terminal acting on the pointer and a bell and battery completing the circuit with the pointer and terminal.

989,458. ELECTRIC CIRCUIT BREAKER; W. Walz, Toronto, Ont., Canada. App. filed March 6, 1909. Avoids fusing of contacts by means of a spring-actuated contact held closed by a spring-held latch which is released when desired.

989,462. REGULATING MECHANISM FOR INCUBATORS; L. L. White, Eugene, Ore. App. filed April 19, 1910. The damper closing the heating chamber is automatically opened and closed by variation of heat through a rotary driving shaft, a pair of alternating operating electric motors and a thermostat.

989,465. AUTOMATIC DISTRIBUTER FOR ELECTRICITY; H. A Wolff, Chaville, France. App. filed Dec. 31, 1910. For operating automatic machines by means of concentric arc-shaped contacts controlled by a radial arm, one of the concentric rings connected with the motor being divided into as many segments as the ring which supplies the working current so that the motor circuit may be automatically and independently modified for each working circuit.

989,487. LIGHTNING ARRESTER; F. E. F. Creighton, Schenectady, N. Y. App. filed Aug. 26, 1909. Electrolytic cells used as lightning arresters, two of their corresponding terminals being electrically connected and the grounding switch mounted to coöperate with the other terminals of the condensers and so ground either one of the other terminals at will.

989,516. FIRE-ALARM TELEGRAPH APPARATUS; N. H. Suren, Needham, Mass. App. filed April 12, 1909. A plurality of mains, controlling main relays, a repeating circuit with switches operated by the main relays, with an actuating mechanism controlled by any one of the main relays and time-controlled so as to hold the switch of the active relay closed and open the remaining switches while the signal is being received by the active relay.

989,518. ARC LAMP; S. P. Wilbur, Wilkinsburg, Pa. App. filed June 2, 1905. Series arc lamp with cut-out after the lamp has burnt out, the movable electrode having a sheath with a projection which operates a portion of the clutch mechanism for cutting out the lamp.

989,529. CONVERSATION METER FOR TELEPHONE SYSTEMS; G. W. Lorimer, Piqua, Ohio. App. filed April 13, 1906. Manual actuating means for the meter, a call sending device, a talking circuit with means for locking the call-sending device and the meter actuator when the talking circuit is in use.

989,549. FILAMENT-MOUNTING MACHINE; W. R. Burrows, Newark, N. J. App. filed Dec. 29, 1906. For securing filaments to leading-in wires, the stems and filaments being on a moving carrier and the paste being applied automatically with means for cutting off the anchor wire and shaping the leading-in wires to the proper width for mounting.